VOL. LXXXII. No. 2103. [All Rights Reserved.] MARCH 15, 1918. [Registered at G.P.O. as a Newspaper and Canadian Magazine rate of Postage.] PRICE FOURPENCE.

LONDON: PUBLISHING OFFICE, 4, BUDGATE HILL, E.C.4. SUBSCRIPTION per annum. Postage inclusive, in Great Britain, £1 1s. 6d. Canada, £1 2s. 10d. (25.80 francs) all other countries, 30s.—NEW YORK: D. VAN NOSTRAND Co., 25, Park Place, New York City. TORONTO, ONT.: WM. DAWSON & SONS, LTD., Manning Chambers. PARIS: BOUVEAU & CHEVILLET, Librairie, Etrangère, 22, Rue de la Banque.
Telegraphic Address: "Agency, Cent., London." A B C Code. Telephone Nos. City 997; Central 4425 (Editorial only).

LITHOLITE, Ltd.,
55—57, Hackney Grove, London, E. 8.
'Phone and Telegrams: Dalston 592, London.
MANUFACTURERS OF
MOULDED INSULATORS,
FIREPROOF AND OTHER GRADES.
ESTABLISHED NEARLY 20 YEARS.

AIR COMPRESSORS & VAC. PUMPS, Desiccators Sets. Cable Pumps & Impregnators.
NORMAN DICKSON, PRINGLE & CO.
25, Victoria St., Westminster, S.W.1

WRIGHT 'Phone: 490. Tel.: Motor.
A.C. and D.C. **MOTORS.**
WRIGHT & WOOD, Ltd., HALIFAX.

EVERY DESCRIPTION OF
SMALL TURNED PARTS and CASTINGS for ELECTRICAL ENGINEERS.
A. MORTON,
6, Tenby Street North, Birmingham.

BROOK MOTORS.
E. Brook, Ltd.,
Empress Works, HUDDERSFIELD.
11, Queen Victoria St., LONDON, E.C.4
See Advertisement, Sup. 42.

SWITCHGEAR.
ERNEST F. MOY, LTD..
Manufacturing Electrical Engineers and Government Contractors.
GREENLAND PLACE, CAMDEN TOWN, LONDON.

TAYLOR & CO.
MICA & MICANITE
INSULATION.
TELEPHONE:—CENTRAL 4675.
40, HATTON GARDEN, LONDON, E.C.

Osram, Mazda, Wotan, "Z" and other Conference Lamps. Pocket Lamps, Torches, Batteries, &c.
E. DAWSON & CO. (W. E. POTT).
24, GRAY'S INN ROAD, London, W.C.1
Telephone: HOLBORN 2794

CHURTON
SINGLE and POLYPHASE
MOTORS.
T. HARDING CHURTON & CO., LTD.,
Atlas Works, Water Lane, LEEDS.

LIFTS and - - - TRANSPORTERS.
Wm. WADSWORTH & SONS, LTD.,
BOLTON.

"EMPIRE" AUTOMATIC CONTROL
FOR
Shell Presses, Compressors, Machine Tools.
ELECTRIC CONTROL, LIMITED, GLASGOW.

WESTERN-ELECTRIC
COMPANY, LIMITED,
Norfolk House, Victoria Embankment, W.C.
Works: NORTH WOOLWICH, LONDON, E.
TELEPHONES & CABLES.
See Advertisement last week, Sup. 9.

CONNOLLY BROS., Ltd.,
for
WIRES AND CABLES.
See Advertisement this week, p. iii.

WHITE
Electrical Instrument Co., Ltd.
2, 4, & 6, GLOUCESTER ST., CLERKENWELL, LONDON, E.C. 1.
Wire: Voltograph, London. 'Phone: City, 8060

LANGDON - DAVIES
ELECTRIC MOTORS.
One, Two and Three-Phase.
LANGDON-DAVIES MOTOR CO.,
110, Cannon St., London, E.C. 4

INSULATING - - BEADS - -
Immediate Delivery.
HOLDER-HARRIDEN LTD., 35/37, Noble St., London, E.C.

SIX NEW LEAFLETS
DEALING WITH SPECIAL TYPES OF TRANSFORMERS, WILL BE SENT YOU ON APPLICATION BY
JOHNSON & PHILLIPS, LTD.,
CHARLTON, LONDON, S.E.7.

Better than Rubber, Leather and Gutta-Percha.
WASHERS.
DERMATINE
DERMATINE CO., Ltd.,
Neate St., London, S.E.5

LARGE STOCK KEPT FOR QUICK DELIVERY
SHUNT REGULATORS,
MOTOR STARTERS and all classes of Resistance Work.
The SOLENOID REGULATOR Co. (GEORGE A. YARWOOD Proprietor),
HIGHGATE SQUARE, CAMP HILL,
Telephone: Midland 688. BIRMINGHAM Telegrams: "Solenoid, Birmingham."

MAVOR & COULSON, Ltd.,
GLASGOW.
MOTORS, DYNAMOS, SWITCHGEAR.

ELECTRIC MOTOR REPAIRS
ARMATURES REWOUND.
H. DUNN & SON,
Newington Causeway,
Tel.: Hop 1167. LONDON, S.E.1

THERMIT, LIMITED,
(Proprietors: THE BIRMINGHAM METAL & MUNITIONS CO., Ltd., BIRMINGHAM)
675, Commercial Road,
LONDON, E. 14.
'Phone: EAST 4157. 'Grams: "FULMEN, STEP, LONDON."

START . LIGHT.
THE
WOODHOUSE AUTOMATIC CLUTCH
PICKS UP LOAD AFTER STARTING.
THE VICTORIA DYNAMO & MOTOR CO.,
CRAVEN HOUSE, KINGSWAY, W.C. 2

INGLEBY & CO., LTD.
ELLAND ROAD, LEEDS.
MOTORS FOR DIRECT AND ALTERNATING CURRENT
Tel. 378
Delivery from Stock up to 50 H.P.

Advertisement Index, see page xxviii.

ENGLISH
EDISWAN
EVERYTHING
ELECTRICAL

The house of Ediswan is the best equipped to deal with all enquiries for
Everything Electrical.
ENTIRELY BRITISH.

The Edison Swan Electric Co., Ltd.
PONDERS END, MIDDLESEX.
London and Provincial Depots.

ACTUAL MANUFACTURERS.

TAPES,
WEBS,
SLEEVINGS,

For all classes of Electrical Work.

Large Stocks kept.

Samples by return on application.

JAMES NORTH HARDY & SON, LTD.,
54, Portland Street, MANCHESTER.
Telegrams: "Hardson, Manchester." Telephone: 6471 Central.
LONDON: 3, Fitchett's Court, Noble Street, E.C.
GLASGOW: 76, Virginia St. BELFAST: 29, Franklin St.

ENQUIRIES SOLICITED.

CASH BUYERS
SCRAP
IRON, STEEL,
ALSO
TURNINGS,
BORINGS,
&c.

A. WEBSTER,
Great Western Railway Depôt,
PARK ROYAL,
LONDON,
N.W.

CASH BUYERS
SCRAP
COPPER, BRASS,
GUN-METAL,
Also Baring
RESIDUES
&c.

TELEPHONE WILLESDEN 2378.

THE SWISS INSULATING WORKS, LD., BRETONBAC (Soleure) (Switzerland.

OLD ESTABLISHED COMPANY with two Factories in Switzerland, employing Swiss Capital and Labour.

PROMPT DELIVERIES *viâ* FRANCE.

Micanite for Stampings and Mouldings, also Flexible. **Amberite** for Commutators, of Indian and Canadian Mica. **Micafolium** Sheets and Rolls. **Mica-Paper,** Linens, Tapes, Band and Presspan. **Commutator Rings** and Micanite Parts for all purposes. **Bakelite Tubes** and Cylinders for Transformers; also in Micanite and Ordinary Paper. **Bakelite Sheets** and Moulded Pieces. Varnished Insulating **Silks, Cloths, Papers** and **Tapes,** straight or bias cut. **Papers,** varnished one side or both, Black and Yellow. Air-Drying and Baking **Varnishes.**

PRICES AND FULL DETAILS ON APPLICATION. *AGENT FOR GREAT BRITAIN AND ABROAD:*

ARCHIBALD CAMPBELL, A.M.I.E.E., 27, Chancery Lane, London, W.C. Telegrams: "Unsubdued Holb, London."

VULCANISED FIBRE.

DIAMOND FIBRE TRADE MARK

In Sheets, Rods, Tubes, and Special Shapes.
Horn Fibre, Diamond Insulation, Press Board, Fuller Board, &c.

DIAMOND STATE FIBRE CO., 57, OLD ST., LONDON, E.C.

N,

st.

E

VOL.

Vol. LX

Economic
"Dayligh
The Elect
Electrical
The Cont
(*illus.*)
New Elec
Correspon
The
Comp
Heati
Legal ...
War Item
Business N
Notes
City Notes
Stocks and
Market Qu
Leaves fro
Insulation
as reg
Processes f
The Röntg
New Paten
Abstracts o
Contractor

THE

The O

TO BE OBT

OFFIC

Tel

Te

The "Electri
by far the L

Subscripti
£1 1s. 6d.; Ca

ADELAIDE: M
Gresham St

AUCKLAND N.
Albert Stree
Engineering
Arcade, Que

BRISBANE: Go

CHRISTCHURCH
Gotch, Manc

DUNEDIN, N Z
Princes Stree

JOHANNESBURG
FONTEIN, D
BETH, &c.:
Ltd.

LAUNCESTON
Cimitiere St

MELBOURNE:
neering Revi
Gordon & Go

Cheques and
THE ELECTRIC
Newgate Street

THE

ELECTRICAL REVIEW.

VOL. LXXXII. MARCH 15, 1918. No. 2,103.

ELECTRICAL REVIEW.

Vol. LXXXII.] CONTENTS: March 15, 1918. [No. 2,103.

	Page
Economical Cookery	241
"Daylight Saving" all the Year Round	242
The Electrical Regeneration of France	242
Electrical Developments in Italy, by E. S. Morgan	243
The Control of Large Amounts of Power, by E. B. Wedmore (*illus.*)	244
New Electrical Devices, Fittings and Plant (*illus.*)	247
Correspondence—	
The Organisation of Electric Supply Staffs	248
Comparative Costs of Steam and Electric Drive	248
Heating Long Tubes Electrically	248
Legal	249
War Items	249
Business Notes	250
Notes	255
City Notes	258
Stocks and Shares	259
Market Quotations	260
Leaves from an Engineer's Log.—II., by "Whistlefield"	261
Insulation under Direct and Alternating Current, particularly as regards Moisture, by Prof. Thornton (*illus.*)	262
Processes for the Manufacture of Aluminium (*concluded*)	263
The Röntgen Society	264
New Patents Applied for, 1918	264
Abstracts of Published Specifications	264
Contractors' Column	Advertisement page xxii

THE ELECTRICAL REVIEW.

Published every FRIDAY, Price 4d.

The Oldest Weekly Electrical Paper. Established 1872.

TO BE OBTAINED BY ORDER FROM ANY NEWSAGENT IN TOWN OR COUNTRY.

OFFICE:—4, LUDGATE HILL, LONDON, E.C. 4.

Telegraphic Address: "AGREKAT, LONDON." Code, A B C.

Telephone Nos.: City 977; Central 4425 (Editorial only).

The "Electrical Review" is the recognised medium of the Electrical Trades, and has by far the Largest Circulation of any Electrical Industrial Paper in Great Britain.

Subscription Rates.—Per annum, postage inclusive, in Great Britain, £1 1s. 8d.; Canada, £1 8s. 10d. ($5.80). To all other countries, £1 10s.

FOREIGN AGENTS:

ADELAIDE: Messrs. Atkinson & Co., Gresham Street.

AUCKLAND N.Z.: Gordon & Gotch, Albert Street; The Mining and Engineering Review, 31a, Strand Arcade, Queen Street.

BRISBANE: Gordon & Gotch, Queen St.

CHRISTCHURCH, N.Z.: Gordon and Gotch, Manchester Street.

DUNEDIN, N.Z.: Gordon & Gotch, Princes Street.

JOHANNESBURG, CAPETOWN, BLOEMFONTEIN, DURBAN, PORT ELIZABETH, &c.: Central News Agency, Ltd.

LAUNCESTON: Gordon & Gotch, Cimitiere Street.

MELBOURNE: The Mining & Engineering Review, 90, William Street; Gordon & Gotch, Queen Street.

MILAN: Fratelli Treves.

NEW YORK: D. Van Nostrand, 25, Park Place.

PARIS: Boyveau & Chevillet, 22, Rue de la Banque.

PERTH, W.A.: Gordon & Gotch, William Street.

ROME: Loescher & Co., Corso Umberto 1° 307.

SYDNEY: The Mining & Engineering Review, 273, George Street; Gordon and Gotch, Pitt Street.

TORONTO, ONT.: Wm. Dawson & Sons, Ltd., Manning Chambers; Gordon and Gotch, 132, Bay Street.

WELLINGTON, N.Z.: Gordon & Gotch, Cuba Street.

Cheques and Postal Orders (on Chief Office, London) to be made payable to THE ELECTRICAL REVIEW, and crossed "London City and Midland Bank, Newgate Street Branch."

ECONOMICAL COOKERY.

ONE of the most remarkable and unlooked-for effects of the war upon domestic affairs has been the extraordinary impetus which it has given to electric cooking and heating, which have made probably more progress in this country during the past three years than in the 10 years preceding.* This applies especially to the use of large cooking installations in connection with the supply of meals on a considerable scale, as in factories, restaurants, &c., and so much practical experience with this kind of work has now been acquired that manufacturers and supply authorities are in a far better position than they were before the war to cope with the requirements of each case on lines that guarantee success. We have confidence, therefore, that in drawing their attention to a new opening for business which has recently presented itself, we shall not only serve their interests, but shall also render good service to the public.

We refer to the strong movement which is now in progress towards the establishment of "communal kitchens," for the purpose of cooking meals for the public on a large scale, thus saving an immense amount of domestic labour at a time when such labour is scarce, and ought to be dispensed with as far as possible, and at the same time securing the highest measure of economy of fuel, food, and money when all these commodities should be husbanded to the utmost. As we have indicated above, it is precisely when employed on a large scale such as is called for by these kitchens that electric cooking is at its best. The descriptions given by Mr. W. A. Gillott of large modern cooking installations in his paper before the Institution of Electrical Engineers are so fresh in the memory of our readers that we need do no more than refer to them; but we may lay stress upon certain features of importance in this connection.

As regards the running cost, Mr. Gillott's experience shows that with electricity at ½d. a unit, and gas at 2s. per 1,000 cu. ft., the former is the cheaper; to the saving in cost must be added the saving in floor space, the perfect cleanliness and convenience of electric cooking plant, the absence of noisome fumes (which in a gas-heated plant necessitate special provision for ventilation), and the certainty of obtaining the same temperature, and, therefore, the same results in cooking time after time. Again, Mr. Gillott confirms the claim that electric cooking materially reduces the shrinkage of meat in roasting, his data showing a saving of more than 10 per cent.; at the present time of scarcity this is a most important consideration. Lastly, the service of communal kitchens is essentially a day load, and will not make any additional call upon the generating plant and mains.

We suggest, therefore, that electricity supply managers should do their utmost to induce the authorities to adopt electric cooking for these kitchens, and we would particularly address this proposal to the engineers of municipal undertakings, seeing that the kitchens are under municipal control, rendering their managers readily accessible to persuasion, and that the kitchens are often housed at the public baths, where hot water is obtainable on the most economical basis, and a supply of electricity is usually available without the necessity of

* Striking instances are given in our "Notes" and "City Notes" to-day.

laying a new service. The opportunity is one which, on every count, ought not to be missed; and we may add that prompt action is essential, for the rival agencies are already opening a campaign with the same object in view.

"Daylight Saving" all the Year Round.

Whatever may be thought of the principle involved in the adoption of the "Summer-time" system—to our mind it is unscientific and artificial to the last degree, being, in effect, a device for tricking ourselves into getting up an hour earlier—it is not denied that under war-time conditions it results in a modest economy of fuel and facilitates the cultivation of allotments, and may be accepted, therefore, as a temporary makeshift until the nation grows up and is able to dispense with make-believe. But it is obvious that what is put on at the end of the day is—or ought to be—taken off the beginning of it, and hence if the period during which the device is employed is too greatly extended, we shall merely transfer the consumption of fuel for lighting and heating from one end to the other, with advantage to no one. This, in fact, is what already happens to some extent in the spring and autumn in the case of the many workers whose calling requires them to rise very early in the morning, and the extension of the period this year to embrace the whole interval between the vernal and autumnal equinoxes will aggravate the trouble.

What, then, are we to say of the proposal put forward by Mr. Samuel Insull, president of the Commonwealth Edison Co., of Chicago, who, according to the *Electrical Review* of New York, strongly advocates a change in time *all the year round*?

Mr. Insull's achievements and position in the electrical world are such that any proposition he supports *ipso facto* demands serious consideration. The conditions obtaining in the United States as regards working hours, &c., may differ considerably from those with which we are familiar here. Mr. Insull estimates that "daylight saving" for five summer months (*sic*. Would that *we* could look forward to five months of summer, instead of the scraps our climate allows of) would save the electricity industry in Chicago about 15,000 tons of coal per annum, and the entire country 230,000 tons of coal; it would save the electric light consumers of the United States 7½ million dollars a year, "this being a loss of income to the lighting companies, with coal the only off-setting saving." All honour to Mr. Insull's altruism. But if daylight-saving were made effective throughout the year, the day power load and evening lighting load would not overlap so much as at present, thus reducing the peak, and saving capital expenditure. This appears to be the main ground upon which he bases his contention.

We may point out, however, continuing the line of argument which we have put forward above, that if this course were followed there would be a heavy lighting, heating, and cooking load in the early morning, which might overlap the traction and power load sufficiently to reproduce the evening peak in the morning hours, in which case no advantage would be realised.

There is also another aspect of the question to which attention may be directed—namely, that the peak is progressively diminishing in importance as the efficiency of lamps improves and the day-load curve fills up. Moreover, the adoption of electricity for heating and cooking is extending very rapidly, and these loads, whilst fairly heavy in the morning, have not been found to add materially to the evening peak. The shape of the load curve, in fact, is changing all the time, and it is not possible to predict it very far ahead. On the whole, we cannot see that any appreciable benefit would be derived from the policy under consideration; it seems to us that it would in the end defeat its own object, for once the change was made, the time for the whole year would be *permanently* set forward, and people would gradually work into their old ways and times regardless of the clock, which eventually would have to be set forward again. It reminds us of the kitten chasing its own tail.

The Electrical Regeneration of France.

It is certain that a very prominent part will be played by electricity in connection with the restoration and reconstruction of the regions devastated by the enemy in the North, North-East, and East of France, which constituted some of the richest industrial districts in that country prior to the war. Already the competent authorities, assisted by the interested professional organisations, have prepared a scheme relating to the measures to be adopted for restoring the economic life of the areas in question on their return to the rightful owners.

Among the urgent problems which will then arise will be that concerning the supply of power to all the establishments (textile, sugar, coal, engineering, chemical, iron and steel, paper, &c.) which will be raised from the ruins. In 1912 the steam plant in the districts ravaged by the invasion was distributed over 10,575 establishments, with an average power of 102 H.P. On the other hand, the output capacity of the distribution companies amounted to about 57,000 H.P., and the length of mains to approximately 3,100 miles. It is assumed that private steam plant, central stations, pole lines and conductors will have entirely disappeared. It would, therefore, seem that the only means of their attaining the desired object will be by the organisation in a rational manner of the production of electrical energy in large works erected on the most favourable sites, interconnected and supplying sub-stations, whence the distributors would be taken to the different localities. Before the war there were no fewer than 236 central and private stations of one kind or another for the purpose of distribution in the districts under consideration. This economic error, according to the scheme now under discussion, is to be remedied by the erection of large stations, which will render useless any small plants in the future, will reduce the transport of coal, and render the railways better able to convey materials for the rapid reconstruction of the districts concerned.

The Chambre Syndicale des Usines d'Electricité, in a report presented to the Ministry for Public Works last September, estimates that it will be advisable to lay down plant of 300,000 H.P. for the purpose in question, of which 100,000 H.P. should be ready on the cessation of hostilities. The Chambre suggests the adoption of the 3-phase system at 50 periods, with identical generating sets each of 5,000 KW. In addition, the Syndicat Professionel des Producteurs et Distributeurs d'Energie has made a study of the question of the unification of the pressures of transmission and distribution, and has set forth proposals which, in the opinion of the Syndicat, appear the best adapted to the purpose. The whole programme is now in course of execution. As, however, time will be required for the erection of the permanent stations and transmission lines, and energy will be needed at once, it is intended to construct temporary stations at first, which will be equipped with the generating sets on order, whilst at the same time recourse will be had to the surplus of energy available at the works erected by the military authorities in proximity to the front and in the reconquered districts.

ELECTRICAL DEVELOPMENTS IN ITALY.

By E. STRACHAN MORGAN.

(Continued from page 221.)

In Italy, distances of over 350 miles are already contemplated; this means that not a single town in the kingdom need be without electric service. The importance of this can hardly be over-estimated in view of the fact that Italy is almost the only industrialised country which has no coal mines, and that, in compensation, it has more potentialities of water-power than any other country. It is estimated that the water-power theoretically available reaches the enormous amount of 40,000,000 H.P. It is most unlikely that more than a small fraction of this will ever be harnessed, even allowing for the greatly improved methods of utilisation that are sure to come in the future. The estimates, official and unofficial, of the power awaiting development vary from 2,000,000 to 6,000,000 H.P., but these are necessarily rather vague estimates. The official estimate of the Genio Civile is 4,000,000. Signor Omodeo thinks that less than 10 per cent., perhaps less than 5 per cent., of the possible available power is now utilised.

A concrete example of what has been done by judicious embankment, even on a small scale, throws some light on these possibilities, and seems to justify enthusiasm. The Brassinone, a small torrent in Emilia that barely sufficed to provide 25 H.P. to a mill, now distributes from 5,000 to 6,000 H.P. In any case, it is most unlikely that either capital or industrial leaders will be available to utilise the minimum estimate in less than several decades.

The development of this industry during the past 20 years may be considered under four aspects: (1) The increase in the number of installations; (2) the gradual disappearance of the smaller companies either by amalgamation with, or absorption by, the larger; (3) the steady decrease in the price of the KW.-hr.; (4) the riveting of the German grasp on the companies.

(1) It would hardly be possible to give the number of installations at any time with accuracy, and even if this could be done it would be but a momentary truth, as they are constantly varying; but it may be briefly stated that whereas in 1891 only 250,000 H.P. were utilised, the latest information is that rent was in 1915 paid for 1,000,000 H.P. It should be noted, however, that rent is in some cases paid in order to keep unused concessions alive; on the other hand, the industrial potentiality is always about 10 per cent. greater than the H.P. on which rent is paid. In some cases, too, rent is paid in order to prevent a rival from utilising what the concessionaire cannot at the time use.

Accepting the accuracy of these figures, it would seem that the average annual increase of power used amounted during this period to about 30,000 H.P. per annum. During these years experience taught the lesson that only enterprises on a large scale were economically sound, and this is indicated by the scale of the demands made. These were on an average:—For the years 1885-1886, 36 H.P.; 1889-1892, 130 H.P.; 1897-1898, 230 H.P.; 1909, 2,160 H.P.; and since then applications have been made for installations as large as 100,000 H.P.

In this connection, the following extract from a statement recently made by Signor Semenza (President of the Electrotechnical Association) is of interest:—

"No official statistics are available later than 1898. I have, therefore, had to depend for information as to the present position on such inquiries as I have been able to make. I have been able to get at the facts regarding 200 new plants, nearly all of which are of considerable importance. I have no details of the numerous small plants, but their total output may amount to 86,000 H.P. The total horse-power of these 200 large plants, established since 1898, amounts to about 593,000 H.P.; add to this the 123,000 H.P. existing in 1900, and the total comes to 716,000 H.P. in 1909. The small unenumerated companies produced, I assume, not less than 72,000 H.P., and thus all the installations in Italy sum up to about 890 H.P. Of the new plants about 580,000 H.P. are water-power, and 110,000 steam. The average annual increase may thus be put at about 60,000 H.P., and the capital invested during the period at about L500,000,000."

If the annual rate of increase has remained constant 1909-1917, this would imply a present horse-power of 1,200,000. It is probably rather less, as the rate of development had shown, at least till the outbreak of the war, a tendency to decrease. On the other hand, a very great impulse has been given to the use of electricity for munition factories, &c., during the war. No figures relating to these developments may be published, but when they are revealed, and when the potentialities of the power thus developed are released for peace work, it will be found that the foundations have been laid for something like an industrial revolution.

Signor Semenza enters this caveat:—"The figures given above must not be taken to represent that actually utilised, as part of the water-power is maintained as a reserve, and part of the steam power is destined to take the place of water-power during periods of drought. Making all allowances, we may reckon the power really used at 630,000 H.P. to 680,000 H.P."

This estimate, if applied to later installations, would reduce the 1,200,000 H.P. *nominal* of the present time (1917) to about 960,000 *actual*, of which, if the proportion continues to be as it was in 1909, about 770,000 H.P. would be water, and 190,000 H.P. steam.

There is a considerable difficulty in reconciling the statistics published with regard to the use of water-power. In the first place, there is some uncertainty as to what proportion of water-power is used directly, and what applied to the development of electricity. Italian statistics are always admirably neat, but do not always hold good under analysis, but we shall not be far from the mark if we assume that 88 per cent. of water-power and 53 per cent. of steam are converted into electric energy. Signor Lanino tells us that rent is paid on 1,000,000 H.P. We may assume that a great part of the 250,000 H.P. used before 1891, and therefore non-electrically, have since then been diverted to electric power, so that these figures imply that the electric horse-power is very considerably more than 750,000 H.P., probably more than 900,000 H.P. On the other hand, an equally good authority, Signor A. Omodeo, tells us that at the end of 1915 the entire share and debenture capital employed in the distribution (and production) of electric power amounted to L600,000,000 distributing 1,000,000 H.P.

Allowance must be made for the fact that though many companies state that part of their energy is produced by water-power and part by steam, they do not inform us what is the proportion of one to the other, nor how far steam power is looked on merely as a reserve.

Some important companies, such as the Societa Elettrica del Adamello, which deals with 50,000 H.P., seem from their balance-sheets to have no steam plant. On the other hand, the Societa Toscana per Imprese Elettriche, though it rents some water-power from another company, depends mainly on steam. Generally, however, one may say that the tendency is to use the steam plant merely as a reserve in case of the breakdown of water-power, and that as the water system is more and more perfected the use of steam will diminish. One reason that prevents or delays the substitution of water-

power for steam is the large capital needed for the installation of hydro-electrical works. Signor G. Semenza states that this cost, including provision of water-power, transmission lines, transformers, &c., amounts to L1,430 per H.P., as against L500 per H.P. for steam.

(To be concluded.)

THE CONTROL OF LARGE AMOUNTS OF POWER.

By E. B. WEDMORE, M.I.E.E.

(Abstract of paper read before the Institution of Electrical Engineers.)

The increasing use of electrical energy and its economical production require the use of larger generating stations and the linking together of existing plants. These extensions involve something more than the use of larger units and the adding of unit to unit. New conditions are reached. Factors which were negligible in smaller aggregations of plant become serious and limiting features.

The forces accompanying a disturbance are increased, and the total number of disturbances to which a system is subjected increases automatically with each extension; thus there are introduced new problems in the design of individual parts of the plant and in the arrangement of them.

There are no insurmountable difficulties in the design of larger machines, heavier cables, and of switchgear all able to cope with larger forces than have yet been met with, but a little consideration will show that the limiting features are to be looked for not only in the generating station, but in the distributing system. Stations and networks spread over a large area may be coupled together without necessarily seriously modifying the forces to be dealt with at any point, but a striking characteristic of developments now in prospect in the principal industrial areas is the increased concentration of large amounts of power in small areas. This inevitably follows the extended use of electricity for domestic purposes as well as for power production, and introduces new conditions not yet fully recognised.

One may double the size of a generating station with advantages in economy, and without excessive expenditure on switchgear, to take care of the conditions in the station itself; but for every machine, switch, and conductor in the main station there are large numbers of smaller machines, switches, and conductors in the distribution system, and if these also are subjected to increased forces a very heavy expenditure may be necessary to ensure satisfactory service. Not only is this true as applied to an individual town, but similar conditions may arise where a large bulk-supply scheme is devised, and a number of existing small plants are linked up to a common and larger source.

It is, therefore, very necessary to give full consideration to the new conditions introduced, and in this paper an attempt is made to anticipate the probable developments of the immediate future, and to show how the conditions arising may be dealt with.

The problem of maintaining continuity of supply and of protecting the plant is found to require for its solution the proper proportioning of the impedance of the different parts of the system.

In this country machines are already building in sizes up to 40,000 K.V.A., and larger sizes are building in the United States. Stations have been laid down for an ultimate output exceeding 200,000 K.V.A., and this figure has been approached in installations already in operation.

It is thought that in this country for some years to come the requirements will be met with stations not greatly exceeding 100,000 K.V.A., and mostly with generating units not exceeding 20,000 to 30,000-K.V.A. maximum rating.

It is not only the difficulties of water supply that tend to limit the size of stations, but in areas within which 200,000 K.V.A. can be utilised there will generally be economy in distribution by the employment of two 100,000-K.V.A. stations, it being under suitable conditions more economical to transport coal and water than to transmit electricity.

As for the size of generating units, it will be seen in what follows that the general use of units of the order of 50,000-K.V.A. output would throw excessive stresses on distribution apparatus and small plant generally unless special precautions were taken. A large unit may fail at a time when another similar unit is temporarily out of commission, pointing to the provision of two spares of the largest size, or an equivalent in smaller machines. This and the fact that such large units could not be employed economically except on large interconnected systems with a total output greatly exceeding 100,000 K.V.A., all supports the contention for the general use of machines of 20,000 to 30,000 K.V.A.

These machines, generating at about 6,000 volts, will be used mostly with transformers stepping up to 20,000 or 30,000 volts for transmission. Generally the machine and transformer bank will form one unit, all switching being carried out on the high-voltage side. There is likely to be an increasing use of overhead lines for distribution of small amounts of power over large areas, but large amounts of power will be distributed through underground cables, on account both of increased freedom from disturbance and of convenience in negotiating densely populated areas.

Means must be found to ensure maintenance of voltage at all parts of the system, and to prevent the disturbance of running machinery. Means must also be found to limit the power which can be concentrated at any point on a fault occurring, and to a figure not calling for excessive expenditure in the construction of individual pieces of apparatus.

By suitably proportioning the impedance of the different parts of the system, and by the employment of quick-acting selective protective apparatus, we can, however, both limit and localise these disturbances.

On a large plant we can to a considerable extent regain the easier conditions of small plants by dividing the system into sections and paralleling these through reactances. This will admit of the interchange of energy for purposes of economy, and at the same time limit both the interchange of energy during severe faults and the disturbances of sound sections.

The employment of reactances for interconnecting, whether between bus-bar sections in an individual station, in trunk mains between bus-bars in different stations, or in interconnectors between adjacent parts of the distributing system, has the distinctive merit that, so placed, they carry only that portion of the load which is being transferred from section to section, and thus waste a minimum of energy, and do not interfere with regulation.

Reactance may also be employed in series in any part of the system, but, so used, the reactance will have to carry the total load fed to that part.

Wherever employed, the reactance limits the disturbance in all parts of the system beyond it, and tends to isolate the disturbance from all parts nearer to the source of supply.

In discussing the use of reactance it is found convenient to rate the reactance in terms of the percentage reactive-voltage-drop it will give on the full-load rating of the part of the plant with which it is associated. Just as we speak, for example, of a transformer having a reactance of 4 per cent., so we speak of a bus-bar section reactance of 10 per cent. based on the current rating of the section.

Reactance may be employed at the source, viz., in or with the generators themselves, where it need not interfere with the losses. It is anticipated that this method will be carried further than it has been hitherto. It is quite feasible to build machines economically with much larger internal reactance than has been common practice. The inherent regulation will not be so good, but the normal load fluctuations on large plants with large machines are relatively slow, so that no difficulty arises in practice.

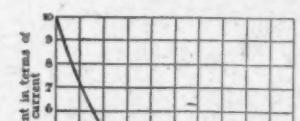

Fig. 1.—Curves showing Decrement of Short-circuit Currents in a Typical Generator.

Most generating sets will be used in conjunction with step-up transformers, the machine and transformer forming one unit. In this case, the transformer reactance will be additional to that in the machine, and will add, say, 4 per cent., but there is no reason why the transformer should not be designed to give more than this, and at a lower cost than that of employing a separate external reactance.

Generator reactance serves only to reduce the magnitude of the short-circuit currents, and does nothing towards maintaining the supply voltage in the rest of the system in the event of loss of voltage by a fault at a point. In order to maintain the supply voltage, we must employ a proper ratio of bus-bar reactance to generator reactance, and of feeder reactance to generator reactance; and as it will be found that the amount of bus-bar or feeder reactance which can be used is limited on account of interference with regulation, it follows that the generator reactance is also limited if a proper ratio is to be maintained between the two.

The rush of current which follows the development of a fault demagnetises the field and reduces the current values, as indicated in fig. 1, but at the first instant the field is sustained by eddy currents set up in the magnetic circuit, and the current is limited solely by the reactance of the windings.

The employment of artificial reactance in series with the

load leads in any case to waste of energy and impaired regulation, and is, therefore, to be sanctioned only where no better solution is available.

Resistance and reactance in an individual feeder anywhere in the system affects disturbances in the following manner :—

(1) The feeder impedance helps to maintain the voltage on all parts of the system connected on the source side of the impedance.

(2) The feeder impedance assists in limiting the magnitude of the fault current at any point beyond the impedance.

(3) The voltage at all points beyond the impedance is equally disturbed.

If artificial reactance is to be employed, functions (1) and (3) call for the reactance to be located as near as possible to the point to be protected, whilst function (2) calls for the reactance to be located as near as possible to the source of supply.

Inherent reactance may be utilised, however, in such a way as to serve all three functions, as may be seen by comparing figs. 2 and 3. Fig. 2 shows power fed through eight feeders to two sub-stations and distributed through 10 outgoing feeders. In fig. 3 the same eight feeders are divided into four groups of two, and there are 16 outgoing cables of smaller section.

It is clear that in the latter diagram we have not only increased the number of sections, and thereby reduced the area affected by a given fault, but we have doubled the impedance between each sub-station and the main station, and greatly increased also the impedance in the outgoing feeders.* Thus by separation of feeders we can introduce more impedance both near the source and near the parts to be protected.

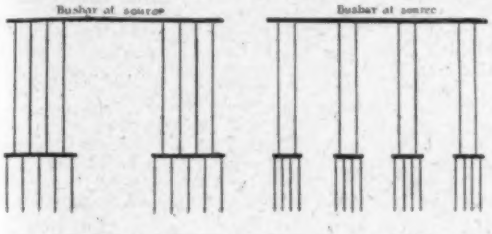

Fig. 2. Fig. 3.

Fig. 2.—Arrangement of Feeders giving Low Inherent Impedance.

Fig. 3.—Arrangement of Feeders giving High Inherent Impedance.

At the same time, if the total section of copper remains the same (neglecting the slight impairment of load factor), the losses are not increased and the regulation is unaffected.

In large systems where step-up and step-down transformers are employed, these introduce further inherent reactance, so that in practice, except where there is considerable concentration of load, the use of artificial feeder reactance should be avoidable.

Where artificial reactance is required it should be put as near as possible to the point to be protected.

The use of series reactance interferes with the regulation to an extent which may be quite serious for lighting unless the energy is transformed to continuous current. The permissible pressure drop ultimately decides the practicability of the proposition.

We conclude that inherent reactance should be utilised as far as possible, and additional artificial reactance should be used only to ensure that disturbances should be sufficiently localised and plant adequately protected against excessive streases. These two conditions require a similar distribution of reactance in the system, but the results obtainable from the standpoint of voltage disturbance depend upon the kind of plant employed.

Where the distribution is by transformer, the voltage must necessarily be disturbed to an extent visibly affecting the lighting on sections adjacent to the faulty one, but the disturbance will last only until the protective gear has isolated the fault.

In the case of induction-motor-driven sets a heavy fall of voltage is not serious so long as the fault is cleared in about two seconds or less, which lies well within the capacity of modern protective apparatus.

In the case of rotary converters and synchronous motors, we have only approximate data. A rotary converter running fully loaded will not be pulled up if the voltage falls to one-third or one-quarter of normal, but the machine is sensitive to sudden changes of phase angle. The reactance which limits the voltage drop also reduces the phase-swinging.

* From the practical standpoint, fig. 3 may require more cables by way of spares, and a larger staff of attendants, but there is an offset in that the sub-stations may be placed nearer to the demand and the average length of the feeder reduced. Moreover, cable can be reduced by interconnecting stations if appropriate protective apparatus is employed, so that, in fact, sub-division can be pushed a long way without increased cost of distribution, and with great advantage from the standpoint of continuity of service.

Faults remote from the source present no difficulty, but we cannot employ sufficient reactance in outgoing feeders in the generating station to prevent the voltage being pulled down on a fault. It is likely, however, that the machines on sound circuits will not be disturbed if the voltage does not drop below 50 per cent. of normal at the source. At the first instant the drop will be much less than this, but the generators will be quickly demagnetised, and the voltage will approach the limit in less than a second.

If the generators have a short-circuit reactance of 15 per cent. and are furnished with potential regulators, it is likely that they would require a feeder reactance of 33 per cent. based on the generator rating to meet this condition. It is not possible fully to protect the rotary converters all the time, even with reactances in each outgoing feeder.

In modern practice, where the mid-point of the system is earthed, all faults to earth will be cleared without serious voltage disturbance, and the large majority of cable faults in particular are of this character. The conditions are further greatly improved by the employment of quick-acting switchgear able to clear a fault in one-fifth of a second or less.

The method of employing bus-bar reactances is intimately connected with the subject of the design and arrangement of

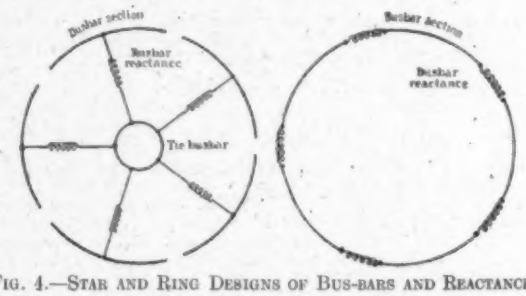

Fig. 4.—Star and Ring Designs of Bus-bars and Reactances.

the bus-bars themselves. It is sufficient here to recognise that there are two distinct methods of connecting up the reactances, known respectively as the "star" and "ring" methods, and illustrated in fig. 4. The star design is generally preferable after considering the operating conditions. Either system will give about equal protection, but here, again, the advantage in the extreme case lies with the star design.

It is the system which has to be sectionalised, and not the main bus-bars alone. Clearly the sectionalising of the bus-bars is of very little value if the sections are tied solidly together outside the generating station. This requires that there shall be a correspondence between the bus-bar sections and the sections of the distributing system. The ultimate plan must as far as possible be pre-arranged from the commencement so that adequate provision may be made in each section of the bus-bar for the ultimate equipment required by the corresponding section of the distributing system.

Current-limiting Effect.—In considering what results can be obtained by the use of bus-bar reactance the subject of the transfer capacity required is important, because for a given voltage difference between sections the amount of current to be transferred limits the amount of reactance which can be employed, and therefore the amount of protection obtainable by this method.

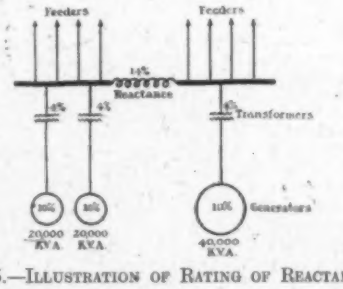

Fig. 5.—Illustration of Rating of Reactance.

In investigating the limiting effects of different combinations of reactances, the reactance associated with an individual machine, whether internal or external, or in the step-up transformer, is treated as one item, described as generator reactance and indicated by the letter A. The bus-bar reactances, however connected, are indicated by the letter B. Thus in fig. 5 A = 14 per cent., B = 14 per cent., and B/A = 1.

Fig. 6 gives a good idea of the results obtainable by the introduction of bus-bar reactances. The short-circuit current, on the assumption that no reactance is employed, is taken as unity, and the curves show how much this figure is reduced by the employment of bus-bar reactance. It will be seen, for example, that with B/A = ½ and with five bus-bar sections the short-circuit currents are more than halved. With five

bus-bar sections, with generator reactance of 17 per cent. and bus-bar reactance of 6 per cent., it is possible to keep the maximum value of the short-circuit K.V.A. down to three times the plant capacity, instead of 10 times the plant capacity, a common figure at the present day. That is, we build a 100,000-K.V.A. plant in which the conditions will be no more severe than in a present-day 33,000-K.V.A. plant.

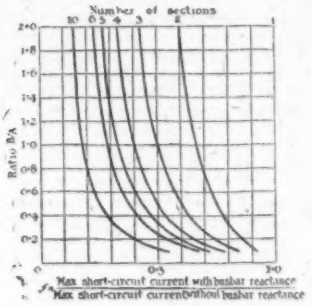

Fig. 6.—Reduction of Short-circuit Current by the Employment of Reactances in "Star."

(To be continued.)

Discussion.

Mr. C. P. Sparks recalled the effects observed on increasing the size of plant tenfold in the early days of the London Electric Supply Corporation, and expressed agreement with the author's remarks on the use of reactance and sectionalising for the limitation of disturbances; reactance in series he considered a mistake, as generators and transformers could be designed to give any desired reactance. Automatic regulation was indispensable to the maintenance of steady pressure. Referring to switchgear, he agreed that this country had led the way, and continued to do so, and he understood that the programme of the Sub-Committee on Coal Conservation presented no difficulty to the manufacturers.

Mr. H. Brazil referred to the heating of cables by very large currents, and doubted whether the figures given by the author were attainable in practice, owing to ohmic resistance and the reactance of bends in the cables; he had known a 10,000-volt arc some inches in length to hang on for some time without blowing a 180-ampere fuse. The destructive effects of direct-current arcs were much greater than those of alternating-current, thanks to the effect of reactance in the latter case; a fuse which was shorted close to a big battery exploded violently, parts of the device being blown to a considerable distance. He agreed that circuit-breakers were in many cases a source of trouble, and recommended Mr. Partridge's device. For high-pressure fuses in feeder circuits, silver wires in oil had done very well indeed; they had interrupted short circuits on 4,000-K.V.A. without breaking the glass cases. He preferred fuses to automatic switches.

Capt. A. M. Taylor was, in the main, in agreement with the author's conclusions. He thought, however, that the author had somewhat over-stated the case for reactances in the bus-bars, in so far, at least, as related to the potential difference between adjacent sections. On referring to Mr. Wedmore's fig. 24, it was found that, with 15 per cent. reactance in the bus, only 0.15 of the load of the bus could be transferred from adjacent sections, if the voltage rise was not to exceed 1 per cent. To transfer half of the load would require something like 3½ to 4 per cent. of potential rise, or, say, 400 volts between bus-bars on a 10,000-volt system. The sub-stations fed from different sections of the main bus-bars would therefore be at from 400 to 1,000 volts difference of potential among themselves, and interconnectors would be impracticable, which took away two or more stand-by cable connections from each sub-station. Another difficulty was with the generators. Let them consider three bus sections, each with its own generator, and that the central section, owing to irregular distribution of the load, was greatly overloaded. The two outside generators are arranged to supply current through the reactances to the central section at unity P.F. If, now, the actual load had a power factor even as high at 0.8, there would still be a 60 per cent. lagging component which had to be supplied by the central machine, and if the P.F. of the load happened to be 0.6 it would be much worse. The central generator, therefore, was "fed up" with magnetising current, and might easily be down to 0.6 P.F. This meant that its angular position was some 60 deg. different from that of the two others, and if a "short" occurred there might be considerable phase-swinging, with even risk of its falling out of step. The author said that the advantage in employing reactance in the generator was that (1) it was cheaper, (2) it did not hinder voltage control. With reference to the first, his recollection was that, in competition with another firm of certainly equal reputation, the machine with the external reactance came out the cheaper (including the reactance), and he was also informed by the builders that with still bigger machines the advantage would be increased. From the user's point of view, he still maintained the greater security of the external reactance which could, in addition, be incorporated in the main bus reactance chamber, and then served to protect the main cables (to the generator), and even the generator oil-switch itself. With regard to Mr. Wedmore's point (2), he knew of no voltage control difficulties that did not apply equally to the two cases. The speaker fully agreed with Mr. Wedmore's notes about the forces obtaining between conductors. The great value of the reactance, as against any known form of switch, was that it operated *in time to prevent the first half wave* of current from being generated. It was this first half wave that did the damage to the windings of generators, &c.

Mr. E. P. Hollis drew attention to the immensity of the forces involved in the operation of modern plant; on one occasion a 6,000-K.V.A. set broke down, and the smoke filled the engine-room, so that the switchboard could not be seen for some time; in another case a switch disappeared, and in connection with a third breakdown the explosion was heard three miles away. With the aid of reactance the short-circuit current could be limited to 10 times the normal value, but the restricted value of the short-circuit current of a modern large set was greater than the unrestricted value of the short-circuit currents of the smaller sets that we had been accustomed to. It appeared to him a barbarous method to break a short circuit on the switchgear; the current should be limited before the switch was opened.

Mr. A. Hamilton Ellis said that some years ago reactance was considered anathema in electrical supply; now one was told to install it almost *ad lib*. The first suggestion came from those who studied supply phenomena, the second from manufacturers. But did not the first suggestion still hold good? He had noticed that the majority of reasons for doing this, that, and the other in the supply business did not come from those who had to live with the job; it might be because the latter had their time fully occupied looking after the breakdowns, &c.; of the plant supplied. Was the installing of reactance coils another camouflage for protecting faultily designed apparatus? In large cable systems they got maximum capacity effects, and if they went on adding inductance in the shape of reactance coils he had not the slightest doubt there would be a tendency for resonance to occur. The author did not say anything about the frequency of supply. If his figures were based on 25 cycles, then for a periodicity of 50 they would require much less artificial reactance, and probably none at all. The author said that there were no difficulties (meaning, presumably, commercial difficulty) in designing apparatus to withstand the increased strains; they why add reactance? It was said that reactance coils limited the disturbances; well, did they? He knew of a 50,000-K.V.A. station where a large machine failed, and the switch failing to clear properly, the resulting arc involved the whole switchgear, &c., shutting the station down. A similar thing happened in another station due to the failure of a current transformer, although both were protected with reactance. One could not say where an arc would finish, although one might strongly suspect where a breakdown would occur. Another point with these breakdowns was that, although both stations were equipped with the latest relays, &c., they were made inoperative due to the control wiring getting burnt up. His experience with reactance coils had not been an unmixed blessing. The most violent short-circuit he had ever had occurred only that week, due to the failure of one of these coils, and before adding apparatus which was liable to breakdown itself, increasing the cost and layout, other ways should be given very careful consideration to carry out the same thing economically. Even the author himself said that each piece of apparatus added weakened the chain, and automatically increased the risk of breakdown, so why perpetuate it? He could not see what the author hoped to gain by stepping up to high pressure for a 3-mile distribution; was he more immune from breakdown at 20,000 volts than at 6,000 volts, or could he give the cost for 6,000 volts against 20,000 volts, including the step-up and down transformer? It might be that after running these super-stations some time we should be like the Germans, having bitten off more than could be chewed.

Mr. J. S. Highfield said that he was quite certain that simplification of the apparatus was most important; perfect certainty of action and great speed were essential. He had been associated with the late Mr. Duddell in experiments on a device depending on the fact that an arc could not be maintained between certain metal contacts with less than 500 volts; a switch constructed of metal disks opening slightly in succession operated with great success on 10,000 volts. It was tested up to 600 K.V.A., but was found to be fully covered by a German patent; why was it not in use? In connection with the general extension of electricity supply, difficulties arose in tapping off for small consumers from lines at 20,000 volts; the amount of gear required was nearly as great for 50 KW. as for 200 KW. In farming districts, 20-KW. consumers would wish to be supplied from the high-pressure lines, but there was no cheap way of tapping them.

Mr. F. H. Clough said that it was quite possible to provide 20 or 30 per cent. of reactance in the generators, where it would protect not only the generators, but also the external apparatus, and maintain the continuity of supply. He recommended the use of generators with high reactance and automatic regulation of pressure; in large power stations

hand regulation would be possible. In America the supply was usually converted to direct current; the power factor could therefore be maintained at unity, and reactance could be put in each feeder sufficient to absorb the whole voltage with a comparatively small current flowing. Here we distributed alternating current, introducing difficulties of regulation. Small feeders should be used, with, say, 5 per cent. reactance. If heavy feeders were employed, large reactance should be inserted, and the voltage should be controlled at the far end.

Mr. A. R. Everest said that with very large plant one must provide correspondingly large factors of safety in the small details. That was sufficiently difficult now, but would be much worse when the "super-power" plants were at work. The reactance referred to in the paper was that which existed under normal conditions, but if a machine became saturated, the reactance would disappear; the value of the reactance should be reckoned with due allowance for the actual conditions.

Mr. J. H. Sandiford said that they were all agreed that reactance would be necessary between the sections of the bus-bars, and suggested that the reactance coils should be standardised. He suggested porcelain in preference to concrete in the construction of the coil, and thought that the bare copper winding shown in the paper would collect dust, and lead to breakdowns between the end turns.

In reply to the discussion, Mr. Wedmore said that the proportions of reactance which he advocated now were about the same as 10 years ago; considerable departures could be made from the ideal conditions without serious results. The frequency assumed for the purpose of the paper was 50 cycles per second. Fuses could be used for small currents, but were not in competition with oil switches. Concrete was used in reactance coils for the sake of strength of construction.

NEW ELECTRICAL DEVICES, FITTINGS, AND PLANT.

Readers are invited to submit particulars of new or improved devices and apparatus, which will be published if considered of sufficient interest.

A Large Motor-Converter.

Our illustration, fig. 1, shows a 2,000-kw., 50-cycle, Peebles motor-converter, recently manufactured for the Sydney Municipal Council, Australia; this makes the fourth 50-cycle motor-converter unit supplied to the municipality in question, the other three machines each being of 1,000 kw. capacity.

A few years back Messrs. Bruce Peebles & Co., Ltd., of Edinburgh, the manufacturers of these machines, supplied to the Manchester Corporation a 2,200-kw., 50-cycle motor-converter; since that time they have received an order for a 2,000-kw. motor-converter (not yet manufactured) for Johannesburg Municipality, and within the past few weeks the Manchester Corporation has placed an order with them for a still larger machine, this time of 2,400-kw. capacity. These, we are informed, are the largest 50-cycle converting units which have ever been manufactured in Great Britain.

The machine shown in the illustration, which runs at 300 r.p.m., is arranged with three pedestal bearings; the bedplate is split longitudinally, the facings being carefully machined and bolted together. Barring gear is provided for barring round the rotating element for cleaning or other purposes when the machine is not in operation.

The a.c. supply, which is switched direct on to the stator, is three-phase, 50 cycles, 5,000 volts, and the continuous-current end, which is shunt-wound, gives its output at 485—540 volts. Owing to the heavy continuous current, viz., 4,125 amps., the d.c. end—as will be noticed from the picture—has a double commutator, and the brush gear, which is carried from the bedplate, is of particularly substantial construction.

The machine is designed to deal continuously with an out-of-balance current equal to 25 per cent. of normal full load, *i.e.*, about 1,000 amps., and with this out-of-balance current the voltage difference between the two halves will not be more than 1 per cent. of the voltage across the outers.

This particular set, for special reasons, is started up from the d.c. end by means of a multiple-lever starter, which is short-circuited with a 4,000-amp. heavy laminated short-circuiting switch after the machine has been run up to speed. When it is installed in Sydney the starter will be mounted on the bedplate between the a.c. and d.c. machines, giving a very compact arrangement.

The a.c. rotor is provided with slip-rings and the usual short-circuiting gear, which latter is brought into use after the rotating element has commenced to revolve, but in the event of the machine ever having to be started from the a.c. end, the slip-rings and short-circuiting gear will come into operation in the usual way for a.c. starting.

The guaranteed efficiencies are 93·5 per cent. at full load, 93·25 per cent. at three-quarter load, and 92·5 per cent. at half load. The temperature rise will not exceed 70° F. after six hours' full load run, and when supplied with alternating current at 5,000 volts, and with the d.c. voltage at 505, the power factor will be unity at 90 per cent. of full load; at 540 volts and full load the power factor will be ·97 leading, while at 485 volts and full load it will be ·98 lagging.

The windings have been specially impregnated to withstand the climatic conditions obtaining in the country where the machine will operate. The magnet frame is divided horizontally, and the complete rotating element is very carefully balanced both mechanically and electrically.

Installed in the same sub-station with two of the 1,000-kw. motor-converters are two Peebles synchronous motor-booster sets. As in the case of the motor-converters, the a.c. ends of these machines are supplied with three-phase current, 50 cycles, 5,000 volts, while the d.c. ends are capable of giving 3,000 amps. at 0—187 volts.

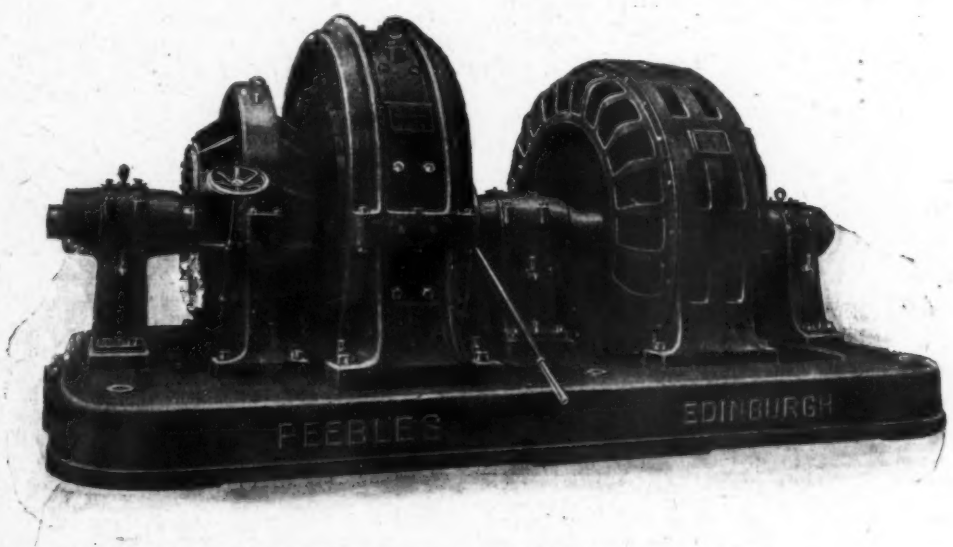

Fig. 1.—Peebles 2,000-kw. 300-r.p.m. Motor-Converter for Sydney.

The Latest Type of Influence Machine.

The Medical Supply Association, of 167-185, Gray's Inn Road, London, W.C. 1, has recently placed upon the market its latest type of the Gaiffe static machine, which is British made and appears to be thoroughly reliable and strong.

The mechanical construction of the machine is simple and very sound. All parts are readily accessible, and the machine can be taken to pieces quite easily, a feature being that there is no spindle, no sectors, and no glass or other enclosure. Sufficient space is left between each pair of plates to allow the hand holding a cloth to be held between, so that the plates clean themselves by rotating against the cloth. Similar machines have been running for several years in different parts of the country, and no new parts have had to be supplied beyond renewing the small leather bands and the brushes as they wore out. The whole machine is built upon a cast-iron table and run by any convenient means. The cost of driving with an electro-motor works out at about ½d. per hour.

The machine is not enclosed in any way, and it excites immediately on rotation. Special attention has been given to the plates, which are of vulcanite. Each plate is formed of three

sheets of different qualities; this does away with the tendency to warp, and enables the outer surfaces to be made of very good quality brittle vulcanite, which in itself would not stand the high speed of rotation. The plates are nearly 22 in. in diameter, and they are run at a speed of from 900 to 1,000 revs. per minute. All the plates rotate at this speed, in opposite directions, equalling in effect similar plates if one were fixed and the other rotated at 1,800 revs. per minute. In the Gaiffe 10-plate static machine it is calculated that 1,275 square metres of vulcanite pass under the brushes per minute. The milliamperage depends on the number of the rotating plates and the speed at which they are run. A 12-plate Gaiffe machine, as shown in fig. 2, will give about 300 milliamperes, and a 20-plate machine about 500 milliamperes.

Other things being equal, the larger the diameter of the plate the longer is the spark obtainable. The 22-in. plates give sparks

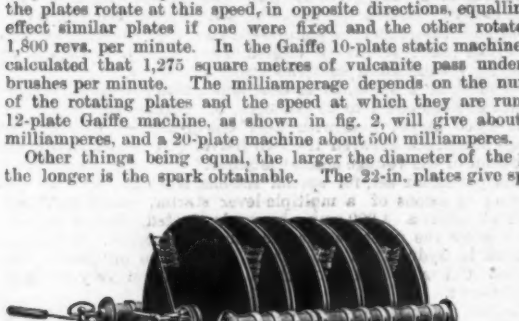

Fig. 2.—The Gaiffe Influence Machine.

quite long enough for most requirements. A 12-in. plate machine running at 900 revs. per minute gives a good discharge between balls 8 to 10 in. apart. In view of the pressing need of a generator of direct current at very high pressures for electroculture and for the precipitation of dust from gases, as well as for X-ray work and cable testing, to which we drew attention in our issue of June 29th, 1917, every new development in this direction is worthy of consideration, and we believe the possibilities of the influence machine are very far from exhausted.

CORRESPONDENCE.

Letters received by us after 5 P.M. ON TUESDAY *cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.*

The Organisation of Electric Supply Staffs.

There has recently appeared in your paper a suggestion of inaugurating and instituting an Association in connection with the clerical staffs of electricity supply undertakings.

May I, therefore, be permitted, through your valuable columns, to call attention to the fact that such an Association has recently been formed, and is called the Chief Commercial Officers' Association, and from this present body an Assistants' Association is about to be established. The objects of the Association are as follows:—

1. To provide means for co-operation and expression and exchange of opinions on all matters affecting the interests of the members of the Association, and of the members of any other Association with which this Association may later become affiliated.

2. To secure recognition of the Association by other kindred Associations, so that when representations are necessary to be made to electricity supply undertakings, such representation may be strengthened by combination of effort.

3. To afford advice and assistance to any individual member, and to extend protection where necessary.

4. To endeavour to promote a superannuation scheme, and to consider Bills before Parliament, particularly in so far as they affect the interests of the members of the Association.

Qualifications of Membership.—The Association shall consist of deputy managers, assistant managers, secretaries, accountants, chief clerks, and (subject to the following condition) senior commercial assistants in electricity undertakings. A senior commercial assistant will be admitted to membership only upon condition that his proposer is his senior officer in the undertaking in which he is engaged.

The Association, up to March 1st, only embraced the municipal electricity undertakings of Greater London. It was on that day decided to extend its membership to all municipal electricity undertakings in the United Kingdom, and by this means it is hoped so to increase the membership of the Association that it shall become a powerful organisation in the interests of this branch of municipal work.

The Association has already justified its existence by securing equitable treatment, and obtaining for some of its members the awards granted by Sir George Askwith on behalf of the Committee on Production.

Finally, may I say the tactics of the Association are not of a militant nature, but it is hoped that it will always achieve its ends by courteous representation and negotiation.

On behalf of the Association, I shall be glad to give any information that may be desired.

N. A. Chesterfield,
Hon. Secretary, Chief Commercial Officers' Association (Electricity Supply Undertakings).

Electricity Works, Townmead Road,
Fulham, S.W. 6.

Comparative Costs of Steam and Electric Drive.

The problems stated by "Steam" in your issue of March 1st should not be difficult to solve. He will, however, be compelled to give more information about his factory before a reliable conclusion can be drawn.

The most essential points to be considered are:—He says "one (boiler) is used specially for the driving." What are the others used for? Could steam be abolished altogether? If not, what proportion of this boiler plant must be retained?

What are the rates of labour, and how many stokers and enginemen does he employ, and what are their annual earnings?

What are his maintenance, interest, and depreciation charges on his existing boilers (for power), engine, shafting, &c.?

What is his actual (power) coal bill per annum, and has he any ash or clinker removal charges?

Has he any indicator diagrams of engine showing actual H.P. developed at varying times during the working week (*a*) with all machines working; (*b*) with all machines idle; (*c*) with various groups of machinery working, such as apparently is possible from the suggested grouping for the electrical drives?

What is the actual or calculated mechanical efficiency of his engine?

What would be the price per unit he would be asked to pay to the Corporation?

As regards the three schemes he suggests for electric driving, probably No. 3 would prove the most economical in running costs, but would involve the greatest capital expenditure.

Tom Hood.

Bristol, *March 5th*, 1918.

Heating Long Tubes Electrically.

The method of heating long tubes electrically, illustrated in your issue of February 8th, reminds me of a Canadian expedient. A hydro-electric plant was flooded out through the bursting of a penstock. This happened in zero weather—35° below zero—and we had first of all to remove 18 in. of ice from the power-house floor. Then we found that the cooling-water service to the bearings of the A.C. generators was still frozen solid. This was a 1-in. iron pipe embedded in the concrete floor, about a foot from the surface. We tried lighting fires on the floor, but the heat did not penetrate down to the pipe. Then our superintendent remembered the adage: "Do it electrically!" We had an exciter available, put clamps and cables at points where the pipe was teed off to bearings and came above ground, forced about 800 amperes through the pipe—and melted the ice.

The sad part of the story is—when the general manager came along and heard of our successful expedient, he merely said:—"What in heaven do you fellows think would have happened to you if you had burnt out the exciter? You were running at about 200 per cent. overload!"

E. Scott Rivett.

Huelva, Spain, *February 28th*, 1918.

A Rotary Problem.

May I ask, through your columns, if any reader will give reasons for the following occurrences on a 1,500-KW. rotary?

The segments of the commutator are alternately light and dark, the dark ones having a better and smoother surface than the light ones. The edges of the segments can be seen to be burnt, through a microscope.

The + brushes pick up copper on their faces, and yet are burnt up to half-way across the face from the leading edge. Copper dust also collects on the + brushes and holders, but the negative brushes are free from this dust, and their surfaces are excellent. This copper dust, magnified, has every appearance of having been burnt.

R.

LEGAL.

Harrison v. Morris.

In the City of London Court, on March 7th, before his Honour Judge Atherley Jones, K.C., an action was brought by Mr. Harry Harrison, trading as the Whitworth Electric Lamp Co., 75, Woodstock Road, Chiswick, against Mr. A. Morris, trading at the Premier Stores, motor outfitters, 165, Fleet Street, E.C., to recover £36 5s. for electric lamps and batteries supplied, as follows:—200 Midgets at 11d., 200 Baby Midgets at 9d., two gross 2-cell thick 15s. 3d., and three dozen 3-cell thick 18s. 6d. Mr. Lipson Ward appeared for the plaintiff, and Mr. Emile Cannot for the defendant.

Mr. Ward said that the claim was for damages for breach of contract by which defendant sold plaintiff batteries for electric torches, with which everyone was familiar to-day. There was an interview on January 5th between plaintiff and defendant, who had done business before frequently. Plaintiff was shown the Midget battery. It had the distinctive mark of "Master" upon it, and was in a red covered case. He ordered 200 Midgets. It was an American article. Of course, in selling things like electric batteries a particular brand was of great importance, because customers asked for the same kind of thing that they had bought before. Plaintiff also bought 200 Baby Midgets. There was no dispute about them, as plaintiff was abandoning his claim for a return of the £7 10s. which he had paid for them. He had paid for all the batteries which he bought of the defendant. Of the Midgets delivered 54 were not as described, as they were not marked "Master," and they were in black cases. Plaintiff refused to accept them, and he claimed £2 9s. 6d. in respect of those. As for the two gross 2-cell thick, the contract was for the sale of Jupiter batteries, which ought to have been manufactured by, and borne the distinctive label of, the Jupiter Co. Instead of delivering two gross he delivered 164. Plaintiff returned the goods not according to order, and now demanded the return of his money. Plaintiff further bought 500 flat batteries, known as "ordinary," and they were to be the same as he had bought before, marked "E.B." The batteries sent were a different kind altogether. For that reason plaintiff refused to accept them, saying they were not according to contract, and he returned them. He now claimed the return of the money which he had paid. Defendant had paid £3 3s. 4d. into Court, with a denial of liability for 76 batteries, which he admitted were faulty.

Mr. Cannot said that the defendant would have taken them back if they had been sent separately, but they were sent with other goods which defendant would not accept. Defendant gave no guarantee as to the description of the batteries sold, but, as a matter of fact, they were all Jupiter goods.

Mr. Ward added that the defendant had offered to abandon his profit of 3d. per dozen on some of the lamps if plaintiff would accept them. There was an express contract to take the batteries back.

Mr. Cannot said that the defendant was willing to have taken back the batteries if sent "at once," and that was not done. The fluctuations in the electric battery trade were very sharp and very great. The price depended on the demand at the moment.

Judge Atherley Jones could quite appreciate that the words "at once" must be taken having regard to the conditions which prevailed. One must consider the exigencies of the delivery companies and the various transport services, and see if there was reasonable expedition on the part of the party returning the batteries.

Mr. Cannot said that Jupiter batteries were supplied with the company's usual three months' guarantee. There could be nothing in the change of the colour of the label, which was unavoidable, having regard to the present-day paper difficulty. The goods were genuine Jupiter batteries.

Judge Atherley Jones thought that the defendant took up a high position when he said he would take back all the goods and return the money. He seemed to have repented of it since. All commercial transactions would be at a standstill, and, indeed, in a complete state of chaos, if that could be done with success, assuming there was due negligence in returning the goods.

Mr. Cannot said there was not. The market price had substantially decreased during the time which plaintiff lost.

Plaintiff said he received defendant's letter on January 10th telling him to return the goods. He tried to get them away by going to two carriers, but they were so busy and short-handed that it was impossible to handle them at once. He went to Carter, Paterson & Co., who promised to collect the goods on January 12th. They did not call for them until January 14th, and they were delivered to the defendant the next day. Then he refused them. They could have been sent in a taxi-cab, perhaps, but they were bulky, and weighed over 100 lb., and would have been refused probably. Prices did not fluctuate from January 10th to the 15th, as alleged.

Mr. J. Beny, manager of the Remoline Co., who manufacture Jupiter electric batteries, said there had been a big fluctuation this year owing to the fact that there had not been the fog this winter which was anticipated. There were very big imports, which came into Liverpool, intended for the Christmas trade, but which arrived the second week in January, and as there was no demand for electric lamps this year because of the increased price, most of the manufacturers were left with a lot of goods on their hands. From January 7th to the present time the prices of batteries had been on the downward grade. Batteries had been selling at 15s. 6d. per dozen, but the price was now 8s. per dozen. On foggy nights there was a demand for electric torches. They could not guarantee batteries now as they used to do, because the raw materials were not guaranteed to him. He could not produce such a perfect battery as he could before the war, because all chemicals had depreciated, and he could get no guarantee with chemicals. To shopkeepers he gave two months' guarantee. If the lamp depreciated they exchanged it within the two months. But once the seal was broken by the customer the lamp was not exchangeable at all, and they might only give half-a-dozen flashes.

In cross-examination, Witness admitted that transport difficulties were very great, but he did not think he had recently taken a week in which to deliver batteries to the plaintiff. It would not be unreasonable, however, to take a week. Then he was not under a contract to deliver at once.

Judge Atherley Jones, K.C., said he was always anxious that decisions in law courts should not conflict with commercial usage or restrict the proper play of commercial enterprise. He was perfectly satisfied that the plaintiff had done his best to return the batteries as soon as possible, and that he had not been guilty of any unnecessary delay. Judgment must be given for the plaintiff for the amount claimed, with costs.

Mr. Cannot said the defendant would appeal, and he asked for a stay of execution, which was granted.

Workman's False Time Sheet.

A fine of £5 was, at the Manchester City Police Court, on Tuesday, imposed on George T. Ward, a workman employed by Messrs. Pearson's, electricians, Hulme, Manchester, for making a false statement in his time-sheet. For the prosecution, it was stated that the defendant's earnings as an electric welder amounted to from £10 to £12 per week, and, in addition, his wife and daughter were earning £4. Defendant was sent by his employers to a contract job at Stroud, but instead of catching the 6 p.m. train on the Monday night he travelled next morning, and charged his time up from six o'clock on the Monday, whereas, in point of fact, he did not start work till four o'clock on Tuesday afternoon.

For the defendant, it was stated that he thought he was justified in charging his "time" from the hour at which he should have caught the train for Stroud, which he missed.

Marconi's Wireless Telegraph Co., Ltd.

In the King's Bench Division, on Tuesday, Sir Fredk. Smith (Attorney-General) mentioned to Mr. Justice McCardie the petition of the Marconi Wireless Telegraph Co., Ltd., to the King, which was down for hearing before his Lordship. He said that he appeared with the Solicitor-General (Sir Gordon Hewart), and that Sir Edward Carson was leading counsel for the plaintiffs. Sir Edward was indisposed, and could not possibly be there that day. It was a very important case affecting the construction of a contract, and indirectly affecting a very large sum of money. Sir Edward asked his Lordship's indulgence to this extent, that the case should be postponed till Thursday.

Mr. Justice McCardie ordered the case to stand adjourned to Thursday.

Osram Lamp Litigation.

In the Chancery Division, on Tuesday, Mr. Justice Paterson had before him two motions for judgment in the matter of the Osram-Robertson Lamp Works, Ltd., v. Malmberg, and the same plaintiffs against the Ostro Light Co.

Mr. J. Hunter Gray said the first case came on as a motion for judgment by consent on agreed minutes which provided for a perpetual injunction, delivery up, and inquiry as to damages, together with costs of the action, costs of the inquiry to be reserved. The second case came on as a motion for judgment in default of defence in respect of the same patent, and the minutes were identical.

His Lordship gave judgment for the plaintiffs in each case in the usual form.

WAR ITEMS.

Exports to China.—The "London Gazette" for March 8th contains names of some further persons and bodies in China to whom exports may be consigned.

Electric Supply Staffs and National Service.—The following letter has been received by Mr. T. W. Cole, secretary of the Provincial Electric Supply Committee, from the Ministry of National Service, and it is to be noted that the assistance that may possibly be given by the Ministry (as mentioned therein) may be of considerable value in certain cases. The booklets mentioned therein may be obtained at H.M. Stationery Office, Imperial House, Kingsway, W.C. 2., viz.: —R.136, List of Certified Occupations (June 23rd, 1917), price

1d.; M.M.130 (revised), Schedule of Protected Occupations (February 1st, 1918), price 2d.

(*Copy.*)

Ministry of National Service,
Room 130, Westminster, S.W.1.
February 20th, 1918.

Dear Sir,—In reply to your letter of February 15th, I have to say that certain men engaged in electrical generating stations are covered by the Schedule of Protected Occupations where such undertakings are certified by the Ministry of Munitions under the Munitions of War Act (see page 28 of copy enclosed). Communications on the subject of men employed in such undertakings should be addressed to the Labour Supply Department of the Ministry of Munitions, 6, Whitehall Gardens, S.W.1.

As regards men not so employed, all applications and appeals on behalf of such men should be made to the Local or Appeal Tribunals, or to the Central Tribunal in the usual way, and the attention of the Tribunal should be called to the reservation in the List of Certified Occupations (see page 20 of copy enclosed). No guarantee can be given that it will be possible for this Ministry to take any action as regards men whose cases have been finally dismissed by the competent tribunals, those being the bodies duly appointed by statute to deal with such cases. If, however, an electrical undertaking attaches special importance to the retention of a particular man, and sends full details of the case to this Ministry in good time before the case comes before the Tribunal, it will receive careful consideration, and the Minister will consider whether instructions can properly be given to the National Service Representative concerned not to oppose the case before the Tribunal. The particulars required are:—Man's name and registered address; employer's name and address; precise occupation of man; Tribunal history (nature of certificate of exemption held, and by what Tribunal granted); and any other form of protection held (*e.g.*, protection certificate under Schedule of Protected Occupations).—Yours faithfully, R. E. Graves, *Deputy Commissioner for Trade Exemptions.*

T. W. Cole, Esq.,
Provincial Electric Supply Committee,
Moorgate Court, Moorgate Place, E.C. 2.

Mr. Cole points out that the L.G.B. Regulations and Instructions to Tribunals, R.173, subsequently issued (dated March 4th), are interesting in connection with above, particularly the following:—

Tribunals are not to hear an application by or on behalf of a man until they have been notified by the National Service Representative whether he assents or objects to the application (Regulation 26). If Tribunals find that there is delay in notifying them, they should communicate with the National Service Representative. An application may be granted without a hearing where the National Service Representative assents, and the Tribunal are satisfied that it should be so granted (Regulation 26).

Exemption Applications.—At Wrexham, on March 4th, the Wrexham & District Traction Co. appealed for W. Jones (32, C 1), electric tramcar driver, and six months were allowed.

At Hastings, an appeal was made for R. Merrifield (Class A), electrical fitter for 18 years with Mr. F. Wordley. The latter said that his firm kept another man's business going, and they were engaged solely on commercial work, and had failed to find a substitute of any sort. The Tribunal allowed a final two months, the man to join up earlier if a suitable substitute is found.

The Bedford Tribunal has decided to withdraw exemption held by T. Wright, electrician at the Theatre, unless he complies with the Volunteer condition within 14 days.

Before the Surrey Appeal Court, Messrs. Reed & Co. appealed for E. Lownes (31, Class A), in charge of the electric plant at Farncombe Mills, and he was given a final two months.

The Weymouth Tribunal has granted conditional exemption, until an efficient substitute is provided, to H. J. Barrow (36, passed for general service), electrical wireman with Messrs. Brooking & Co., electrical engineers.

At Leyton, the National Service Representative appealed against exemption granted to E. G. Francis (33, Class A), motorman on the U.D.C. tramways, and he was put back until a substitute is found.

The Enfield Tribunal has granted three months' exemption to S. C. Wisbey (39), engineer and storekeeper with the Ediswan Electric Co., Ltd.

At Folkestone, the National Service Representative applied for the withdrawal of conditional exemption granted to Messrs. Cripps and Payne, switchboard attendants at the electricity works, on the ground that they had failed to fulfil the conditions by not attending the drills with the Kent Volunteer Regiment. Mr. T. Hesketh, manager to the Electricity Co., said that it would have been possible for the men to have attended the drills, and he regretted that they had not done so. Important work was being done by the company, and he was in no way anxious to keep the men if he could find skilled substitutes. Unfortunately, he could not do so, and his staff was already reduced to a minimum. Mr. Swoffer (a member of the Tribunal) said that he had been told that a man applied for the post of switchboard attendant, and offered to work for nothing until he was trained, and that Mr. Hesketh had refused his services. Mr. Hesketh replied that this was quite likely. He could get any amount of unskilled labour, but what he wanted was skilled men, and they were entirely unobtainable. All his apprentices had gone, and both the men appealed against had made arrangements to join the Royal Flying Corps, and might be called upon to join up at any moment. The exemptions were withdrawn.

At Brixworth (Northants), Earl Spencer appealed for further exemption for the electrical engineer at Althorp House (34, B 2), and he was given until May 1st, with regrading in the interval.

At Colchester, on March 4th, exemption was sought for F. Howard (18, Grade 1), electrician at the Hippodrome, but he was directed to report for service by March 30th.

At Broadstairs, on March 5th, the Isle of Thanet Electric Traction & Lighting Co., Ltd., asked the tribunal to waive the Volunteer condition imposed with conditional exemption granted to two employés, and the request was acceded to.

At Deptford, exemption was applied for for E. Brown (39, Class A), sole electrician at the mills of Messrs. Lake, and three months were granted, with leave to appeal again.

Before the North Devon Appeal Court, appeals were made by the Military against G. W. Branch and F. Bickford, both in Grade 3, electricians, of Barnstaple, who had been granted six months' exemption by the Local Tribunal. The appeals were disallowed, and the exemptions confirmed.

Rochdale Tribunal, on the recommendation of the Advisory Committee, has granted exemption until June 30th to F. Walton (29, C 2), overhead linesman, and R. H. Hogg (38, C 1), motorman, applied for by the Corporation tramway department.

BUSINESS NOTES.

Easter Holidays.—The Electrical Review for March 29th will, as usual in Good Friday week, appear two days earlier. In consequence thereof, it will be necessary for all correspondents, contributors, &c., to send in their matter well in advance of the usual time. A notice concerning advertisement copy arrangements for the week will be found in our advertisement pages to-day.

Book Notices.—"Register of Overseas Buyers." London: Bemrose & Sons, Ltd. £1 1s. net.—This is the first edition of a work published for the use of British producers, manufacturers, and merchants. It consists of a list of buyers, agents, and importers in our Colonies and Dominions and in Allied and Neutral countries, together with information on Customs, tariffs, imports and exports. It is stated that it has been compiled with the assistance of Chambers of Commerce and H.M. Consuls abroad. Firms interested in after-war trade projects will need publications of this character.

About British Magnetos is the title of a handsome brochure which has been issued by the Publicity Department, British Magnetos, 8, Breams Buildings, E.C. 4, explaining why so few magnetos were made in this country before the war, how the Germans captured the trade, and how the outbreak of war, by cutting off the supply, resulted in the creation of a practically new British industry, entailing a vast amount of research work and experiment, but leading to the evolution of better magnetos than were ever imported. The success attained was largely due to the formation of the British Ignition Apparatus Association, embracing nine firms which are co-operating in the production of interchangeable standardised machines of the highest class. The achievement undoubtedly represents a triumph of British energy, organisation, and technical skill, and the brochure, which can be obtained on application, admirably illustrates the machines and their applications in war-time.

"What Industry Owes to Chemical Science." By R. B. Pilcher and F. Butler-Jones. London: Constable & Co. Price 3s. net.

"Mathematics for Engineers." By W. N. Rose. London: Chapman & Hall. Price 8s. 6d. net.

"The Electron." By R. A. Millikan. Chicago: The University of Chicago Press. Price $1.50 net.

Advice Respecting the Italian Market.—In the *Bulletin* of the British Chamber of Commerce for Italy (Inc.) for October-December there is a good deal of matter relating to the need for effort to expand trade between Britain and Italy. At a meeting of members held at Genoa, in December, one of the speakers, Mr. Albert de Thierry, urged that the very first step to take was the reform of British weights, measures, and currency. He said that in the good old days British trade was paramount, and if we had been beaten, it was by superior organisation. Conservatism was played out, and British manufacturers must take into account the real needs of the country; the consumer must be studied, and the coming trade war would be terrible. If firms in Britain would help them in the little things that made for increased trade, they could be sure of going ahead. He thought that British firms had had so much business in the Colonies that they had forgotten the old markets, but he knew British manufacturers who were already preparing to cater for Italy. We sold on bill of lading in English currency; the Germans delivered into the customer's store in Italian liras. Lieut.-Colonel Lord Hythe, who has been visiting the various branches of the Chamber addressing members, in the course of an address at Tuscany strongly impressed on those present the necessity for deciding now what was to be done and in what direction we were to supplant German goods on the Italian market after the war. He insisted on the necessity of all Britishers pulling together, this having been the strength of the Germans. A very important question was the supplying of raw materials and machinery. Several hydro-electric railways were contemplated in Southern Italy, and Great Britain would be interested therein. A later speaker (Count Parravicino, of Florence) stated that cheap transport was essential; only high-class, expensive goods could afford coming by rail, while the more necessary raw material and cheap goods came by sea after a lengthy and costly voyage. "German success had been largely through cheap and fast transports. Sample showrooms were also a very good thing. Business must be canvassed for by good agents and travellers knowing Italian. The system of developing industries in Germany was more perfect that in England; they

made quite a study of it. He instanced the establishment of industrial schools, and very especially the sending out of young men to foreign countries to study languages, business methods and trades, whereby they acquired knowledge of the needs of every country. Their banking organisation had also largely contributed to German success, and it would be necessary to institute a similar financial organisation."

Elsewhere in the *Bulletin* there are collected extracts from letters, &c., relating to the question of competition and ways and means for furthering export trade. The German organisation for resuming the export trade is stated to be very complete, and the view is emphasised that, without better organisation, we cannot expect to keep pace with other countries. Germany is stated to be unabashed, unashamed, and confident that she will push her way into the world's markets again. Though German ships have been driven from the seas, Germans have not let the grass grow under their feet. "The more we scan the export horizon, the more the need for the thorough reorganisation of British trade becomes obvious." "Germans . . . with less original genius or inventiveness, but with a greater readiness to face new business problems in a practical spirit, ingratiated themselves into markets in our own domains or at our very doors." One writer summarises legitimate and illegitimate German methods as follows :—

German legitimate methods :

1. Sending a traveller and having a resident agent for each country.
2. Supplying better-finished goods and articles better adapted to the country than British manufacturers offered.
3. Issuing catalogues in various languages.
4. Selling their goods in foreign money duty paid, and giving weights and measures in kilos. and metres.
5. Putting up their goods in more attractive style, and labelled in Spanish, &c.

Illegitimate methods :

1. Putting British trade marks on their very worst quality goods.
2. Putting up their cheapest rubbish on cards, or in boxes, printed in English.
3. Buying British patented articles from England in tens or grosses (to cover themselves), but making infringements of the same article in hundreds of grosses and selling both together.
4. Generally infringing British patents and marks when it paid to do so.

We quote one other writer, who says that before the war Germany had almost a monopoly of the importation of machinery into Italy. This was the natural consequence of Germans having got control of the most important banks, who made it almost a speciality to finance the leading manufacturing companies in Italy. By this means the German financiers, closely in touch with the German industrial rings or "cartels," were able in most cases to control the affairs of these companies, and to obtain all plant or machinery required from Germany, or from other German-controlled companies in Italy. Only very few important concerns were outside this German influence. The writer continues :—

With regard to the future, I think that the industrial development that has taken place in Italy during the war will render this country much more independent than formerly, as far as the mechanical industry is concerned, so that in no case will it require imports from abroad to anything like the scale it has done up to now. However, owing to the dearth of fuel and iron, Italy will always be unable to compete with the larger manufacturing nations for the manufacture of heavy machinery where coal and iron are the principal items, so that it will always continue to be a large importer of this class of machinery. If the British machinery manufacturers desire to seriously tackle this market, it will not be sufficient for them to send down travelling agents and a quantity of illustrated catalogues and other interesting literature dealing with their manufacture, but they will have to organise well equipped offices, shops and showrooms fitted with a large selection of their products, full sets of spare pieces, repairing shops, &c., in the principal industrial centres, and hand over the management of these agencies to able and well-paid people, who would be required to keep in close touch with the management of the big limited liability companies who are almost the sole purchasers of this class of articles. The British manufacturers ought also to be prepared in some cases (like the Germans) to give long credits, and occasionally also to accept part payment in the form of shares or debentures in the companies of their clients. Of course, these facilities would only be granted after the closest examination into their clients' business, and with the participation of one or more representatives on the board of directors of the purchasing companies.

Electrical Imports of Chile.—In an article advocating the creating of new industries in Chile, the *Boletin de la Sociedad de Fomento Fabril* gives the following particulars of Chilean imports of electric glow lamps in the four years 1912 to 1915 :—In 1912 there were imported 159,651 kg., of a worth of $798,205 ; 1913, 214,938 kg. = $1,074,690 ; 1914, 79,201 kg. = $396,005 ; and 1915, 91,392 kg. = $459,960. The year 1913 may be considered a normal year, and the contributing countries were as follows :—Germany, 169,472 kg. = $847,360 ; United States, 32,160 kg. = $160,550 ; Great Britain, 7,850 kg. = $39,250 ; France, 2,051 kg. = $10,105 ; Belgium, 1,793 kg. = $8,965 ; Holland, 1,135 kg. = 85,675 ; and other countries, 557 kg. = $2,785. Glow lamps are subject to a Chilean Customs duty of $0·04 per kg., but the *Boletin* advocates in the interests of the native industry an increase to $2 per kg. Other electrical imports in 1913 were to the following extent :—Machines and electrical apparatus, 1,836,421 kg. = 1,198,490 ; machines and accessories for electric lighting, 2,928,565 kg. = $1,807,340 ; telephones, 3,130 kg. = $136,061 ; telegraphic apparatus, 1,109 kg. = $4,742 ; insulators for telegraphs and telephones, 333,110 kg. = $266,488 ; accessories for telegraphs and telephones, 144,855 kg. = $151,637 ; making a total of $3,564,758. The above figures are exclusive of electric motors and electric traction material. The *Boletin* points out that the Chilean market affords a steadily increasing opening for electrical plant throughout the whole of its territories, and in particular for telegraphs, telephones, lighting, traction and motive power, and electrolysis. Moreover, machines, apparatus, and instruments for electrical industries enter the Republic duty free.

Rubber Stocks in Brazil.—According to a Rio de Janeiro dispatch to the *Financial Times*, a large quantity of the 1917 crop from the Amazon States, Matto Grosso, and the Acre territory is accumulating on the quay at Manaos. The Federal Government in order to remedy this had ordered Brazilian steamers on their way to the United States to call at Manaos. As, however, the American market was not sufficient outlet, the Minister of Commerce asked the Brazilian Lloyd to commence a monthly service direct from Manaos to Liverpool. This service is now going regularly, and will continue until the Amazon rubber has been cleared off and the difficulty solved.

Trade Announcements.—Messrs. Simpson Brothers, electrical engineers, North Street, Hapton, Burnley, have secured additional premises for their magneto works.

In consequence of the Government having commandeered their Kingsway offices, the Keighley Gas and Oil Engine Co., Ltd., have removed to Albion House, 59-61, New Oxford Street, London, W.C. 1.

Catalogues and Lists.—Messrs. Johnson & Phillips, Ltd., Charlton, London, S.E. 7.—A number of new illustrated leaflets dealing with transformer pillars, H.T. transformers for test-room and other purposes, outdoor sub-station transformers, and E.H.T. transformers for special purposes. Booklet of ten pages, giving data and net prices relating to their V.I.R. cables.

Sun Electrical Co., Ltd., 118-120, Charing Cross Road, London, W.C. 2.—Eight-page illustrated list, giving particulars and prices of their Sun portable electric tools—grinders, drills, and buffers—such as are being used in aeroplane factories and munition works.

Furnace Developments.—The Davis Furnace Co., of Luton, report that during the last two months the character of the demand for furnace plant has totally changed. Whereas for the last two months of 1917 about 85 per cent. of their orders were for crucible furnaces for metal melting, for the first two months in this year the position is reversed, and now at least 80 per cent. of their orders are for furnaces of the oven type, principally for heating steel billets and plant for tool-making purposes, increased pressure upon contractors by certain Government departments being accountable for the change.

Liquidations.—British Huhn Metallic Packing Co., Ltd.—A petition for the winding up of this company, presented by the Board of Trade in the matter of the Trading with the Enemy Amendment Act, is to be heard on March 19th.

LIGHTING AND POWER NOTES.

Australia.—The report of the Sydney Electric Light and Power Supply Corporation for the half-year ended October 31st shows net profits £15,724, compared with £13,430 in 1916. A dividend of 8 per cent. per annum was paid, £5,100 was allocated to depreciation, making a total of £37,602, and the reserve fund stands at £38,110. The total share capital is £216,479, and the debentures £60,800.—*Sydney Daily Telegraph.*

Birmingham.—Price Increase.—The City Council, at its last meeting, approved of the recommendation of the Electric Supply Committee to raise the prices charged to high-tension consumers by 10 per cent., to be added after the Coal Clause has been taken into account ; and for low-tension supplies by 15 per cent. Alderman Jephcott, chairman of the Committee, stated that the charge to the tramway department for traction supply would also be increased by 10 per cent., to be added after the Coal Clause had been calculated.

Bonnybridge.—The bursting of a large cast-iron pipe at the works of the Scottish Central Electric Power Co. caused serious dislocation of work throughout Stirlingshire and Linlithgowshire. Over an area of 400 sq. miles, labour in a large number of iron and steel works, brick works, and collieries was entirely suspended. In a number of the steel works the furnaces, which were fully charged, cooled, necessitating the blasting of the solid contents.—*Evening Gazette Aberdeen.*

Bootle.—Linking-up.—Asked at the Town Council as to the progress of the scheme for the interconnection of the electricity undertaking with that of Liverpool, Mr. Scott said they agreed to the principle of the agreement in January, and did not want winter to come again before they were connected. The Mayor stated that both sides were now practically agreed upon the matter, though the agreement had not been actually signed.

Bradford.—Price Increase.—The Electricity Committee has decided to recommend the City Council to increase the charges for electricity from April 1st as follows :—Bulk supply and power users (including long-term contract holders) to pay, in addition to the existing basis rates, ·015d. per unit for every 6d. or portion of 6d. per ton increase in the price of coal over and above 9s. per ton ; the accounts of all other classes of consumers which are not subject to the coal clause to be increased by 20 per cent.

Braintree.—Proposed Prov. Order.—The U.D.C. is considering a draft agreement, with prices and terms, submitted by Messrs. Crittall in connection with the prov. order for which they are applying.

Canada.—Conservation of Electric Power.—By an Order, dated January 8th, issued in regard to the conservation of power in Ontario, all commissions, companies or persons generating, distributing or using electrical energy in Ontario, where there is a shortage of energy, or where energy is being generated or supplemented by steam, gas, or oil plants, are directed to practise strict economy in the use of electrical energy. The commissions, companies, and the officers of corporations, as well as individuals using electrical energy, have been enjoined to see that no electrical energy is being used for advertising or ornamental lighting; that electric street lighting is reduced to the utmost possible limit—discontinuing cluster lighting entirely, and only using such lamps as are actually necessary for the safety of the public. The Hydro-Electric Power Commission of Ontario has also issued an Order, dated January 8th, to the same effect, addressed to municipalities, commissions, companies, or persons being supplied by the Commission. It has been decided to spend $1,800,000 on an addition to the plant of the Ontario Power Co., which the Commission acquired last year. This will provide 50,000 additional H.P. before the end of 1918, about 15,000 of which will be available for use by August next. The matter is considered of such urgency that the necessary machinery and plant will be purchased with the least possible delay.

Carlisle.—Price Increase.—The Electricity Committee of the T.C. has increased the charges for energy by 5 per cent., making an increase of 25 per cent. upon pre-war charges, as from the meter readings for the current quarter.

Clayton.—Prov. Order.—The District Council, last week, decided unanimously to oppose the application of the Electrical Distribution of Yorkshire, Ltd., for a prov. order to supply current to Clayton, and resolved to accept the Bradford Corporation's terms of supply.

Continental.—Italy.—Further limitations have been imposed in Rome on the use of electricity for both lighting and heating.—*The Times.*

There has been formed at Rome the Società Mediterranea di Elettricità Anonima, with a capital of 11,000,000 lire, whose objects are the discovery and utilisation of hydraulic powers, the acquisition of concessions for the same, the production of electrical energy, the erection of plants for the same objects, &c.

An exhibition has been organised and held by the Associazione Elettrotecnica Italiana in the Salon of the Associazione Industriali at Milan of electric welding machinery, which has excited keen interest. The exhibition was intended to be for one day only, but was extended to three in consequence of the concourse of those interested in technical matters attracted to the display and demonstrations. The Under-Secretary of State, Signor Bignami, the local Industrial Mobilisation Committee, and the Ministry of Industry sent delegates. The exhibitors comprised the leading Italian electrical firms, the State Railways, &c. A paper on the results of the experiments and on the various exhibits was compiled and read by Prof. Lori.

At the outbreak of war the water power utilised in Italy for the generation of electric motive power totalled 1,000,000 H.P., and to reach this figure a period of 30 years was necessary; lack of initiative and capital were the chief hindrances which caused this slow growth of the electrical industry in Italy, notwithstanding the great store of water power available. The industrial activity provoked by the war had a great influence on the development of the electrical industry. Since the first dispositions made by the Government in favour of the industry, the applications for water concessions for electric uses have been steadily augmented. Concessions totalling over 250,000 H.P. are already planned and under way, while favourable reception has been accorded to concessions standing for 500,000 H.P. If to this large aggregate of 750,000 H.P. be added the 1,200,000 H.P. utilised without lawful title, this gives some 2,000,000 H.P. which will in a few years be in full working condition. In later years there have been concessions granted for water supplies of exceptional importance, such as the "Sila," in Calabria, for over 100,000 H.P., and the "Orco," in Piedmont, for 70,000 H.P. Recently the investment of capital in the electrical industry has increased considerably, as witnessed by a net total of new investments of 108,090,000 lire for the first half of 1917. This increase is more than double the average yearly increase for the period 1910-1916. To this remarkable increase must be added those not negligible sums invested in the construction of hydro-electric plants by metallurgical companies to provide directly the energy needed for the manufacture of military material. Electric share companies, indeed, occupy the foremost rank among industrial companies in the official statistics as regards capital invested, and thus the electrical industry at length takes the leading place both financially and industrially, and has before it a promising future.—*Società per Azioni (Rivista Tecnica d'Elettricità.)*

Doncaster.—Wages.—Employés in practically all Corporation departments, to the number of about 250, who are members of the National Amalgamated Union of Labour, last week gave seven days' notice of intention to cease work unless their demands for an 8s. per week advance for men over 18, and 4s. for youths, were conceded. They rejected the Corporation's offer of 3s. The matter has been referred to the Committee on Production.

Exeter.—Wages.—The City Council has agreed to increase the pay of the members of the technical and clerical staffs of the electricity department on a scale corresponding to that of the finding of the Committee on Production.

Leith.—Proposed Extension.—The electrical engineer, reporting on the proposed extensions to the generating plant at the electricity station, recommends the installation of two new generators, each of 1,500-KW. capacity, at a cost of approximately £53,000 for D.C. plant and £62,500 for A.C. plant, with all accessories. The report has been remitted by the Town Council to the Management Sub-Committee.

London.—Hammersmith.—The Electricity Committee considers it necessary to insure against air raids the stock of coal at the electricity works, in the sum of £22,500.

The Committee reports having granted the applications of the L.C.C. and the L.G. Omnibus Co. for electricity for the illumination of certain signs during the necessary lighting hours, at the rate of £5 per 60-watt lamp per annum.

Manchester.—Clerks' War Bonus.—A suggestion that the wages awards granted to the clerks in the Dickinson Street electricity generating station should be extended to the clerks in the electricity department at the Town Hall was deferred at the City Council last week. It was explained that an award was expected shortly that would include a system of grading.

Morecambe.—Price Increase.—The T.C. has advanced the price of energy as from April 1st to 6½d. per unit for lighting and to 3½d. for power and heating.

New Zealand.—Year's Working.—The report of the second year's working of the Lake Coleridge hydro-electric power undertaking to March 31st last shows total revenue of £20,754, as against £8,518 in 1916, working expenses £12,889, gross profit £7,865, interest and depreciation £19,821, total deficit (including depreciation) £11,956, as against £17,649, the result of the previous year's working. Mr. Evan Parry, the chief electrical engineer, reports that the rapid growth of the business indicates that by the end of the current year (the third year of operation) the plant will be earning sufficient to meet both interest charges and working expenses, and will yield a surplus for depreciation and reserve. The total capital expenditure was increased during the year from £320,930 to £336,984, the main item of expenditure being the installation of a fourth generating set of 1,500-KW. capacity, raising the total power-house capacity from 4,500 KW. to 6,000 KW., equivalent to 8,000 H.P.; a fifth turbine and generator set of 3,000 KW., together with material for additional pipe lines, has been on order for some time. Total connected load 17,083 KW., energy sold 11,664,961 KW.-hours, as against 3,994,769 KW.-hours in 1916; maximum load, 4,366 KW., as against 1,372 KW.; average weekly load factor, 52·9 per cent. Arrangements have been made with the Christchurch (N.Z.) Tramway Board for the use of the whole of their steam plant, amounting to 2,000 KW., for stand-by purposes.

Proposed Hydro-electric Development.—The New Zealand Government authorities are having a report prepared upon the question of the development of hydro-electric power in the Province of Southland. Southland has the largest amount of undeveloped water power in New Zealand, and it is proposed to develop a scheme that will yield sufficient power to serve the whole of the province. The Southland League (Inc.) has asked the Government to place legislation on the Statute Book enabling districts such as Southland to carry out their own schemes of electrification. The proposed scheme is based upon the "Local Railway Act."

It is realised that the actual supply of plant by United Kingdom firms is hardly possible under existing conditions, but the information furnished may be of interest as an indication of developments which will undoubtedly become of great importance in the future.

Oldham.—War Bonus.—The T.C. has decided to grant a further bonus of 12½ per cent. to all employés in the electricity department, in accordance with Sir George Askwith's award, but the application for a further 5s. war bonus per week has been refused.

Pembroke (Dublin).—L.G.B. Inquiry.—Mr. P. C. Cowan, chief engineering inspector of the Irish L.G.B., held an inquiry, on Monday, last week, into the application of the Urban District Council for sanction to a loan of £10,000 for the completion of the scheme for extending the electricity supply.

Power Bill.—Worcester City Council is among the latest to oppose the Bill being promoted by the Shropshire, Worcestershire, and Staffordshire Electric Power Co. It was reported at the last meeting of the Council that on the initiative of the Wolverhampton Corporation it had decided upon a united course of opposition. There were now 22 petitions against the Bill.

Salford.—War Bonus.—In discussing the question of war bonuses, last week, Ald. Phillips said the Corporation was paying in war bonuses a sum equivalent to £29,800 annually to gas workers, £45,000 to tramway workers, £10,500 to electricity workers, and to other departments certified under the Munitions Act, £52,000, or a total of £137,400. If the Committee on Production acceded to requests from some of the departments for a further bonus, there would be a further sum of £61,500 required, and if on lines of justice and equity they dealt with the uncertified workers, there would be a further increase of £47,000. If what he anticipated came about, the total payment would be £246,000, or more than £1 per head of the population. Including the amount they would have to pay under the more recent increases, the sum was equal to a rate of 4s. 3d. in the £, and, with others,

that would probably reach 5s. 1½d. The worst of the situation was that some men were getting more than others without adequate reason. Electricity workers were getting 20s. and 12½ per cent., but he doubted very much that the cost of living to those was more than it was to the uncertified employés who had been receiving 12s. a week bonus. The Council decided to increase the latter bonus to 14s.

Bulk Supply.—At the Town Council, last week, Councillor Billington, chairman of the Electricity Committee, referred to the increased use of electricity in the borough, and hoped that the Council would support the Committee in its proposal that the Manchester Corporation and the Lancashire Electric Power Co. should supply energy in bulk to Salford. Salford was handicapped, he said, in possessing an old station which could not be extended owing to the war. The Committee had carried out certain improvements, however, which had enabled it to increase the output from 15 million units in 1914 to 32 million units, and, despite the big expenditure, it had reduced the debt very considerably. As it could not meet the present demands, it must ask for outside help. The Council approved the proposal.

Sheffield.—Loan Sanction.—The L.G.B. has sanctioned the borrowing of £11,125 for railway sidings and capstans, cables and auxiliary board, fans for boiler house, accumulators, coal shoots, &c., for the electricity undertaking.

Stoke-on-Trent.—Plant Extension.—The T.C. has applied to the Ministry of Munitions for a priority certificate for additional plant at the electricity works. It has been decided that new electrical services cannot be granted at the present time to houses where gas is already installed.

Swansea.—Price Increase.—Owing to the cost of production having increased by 80 per cent. in wages and 84 per cent. in fuel, the engineer (Mr. J. W. Burr) recommends that a war charge of 12½ per cent. be added to all accounts for electrical energy, except contracts. The Electricity Committee has agreed to the recommendation, the charge to become operative from April 1st.

Tasmania.—The Government Hydro-Electric Department, owing to the increased demand, and the inability—owing to the war—to secure the necessary plant to supplement the supply, has taken steps to limit any further demand on the scheme for the present. The following regulations came into force early in the year:—No further extensions will be made to the department's reticulation system, and no further poles or distributors will be run to connect up consumers; only approved lighting consumers will be connected, and these only where present distributors and transformers are of sufficient capacity. No additional electric heating or cooking apparatus will be connected to the department's system under any circumstances. Until further notice no motors whatever will be connected to the system. As soon as the position improves sufficiently the restrictions will be removed.—*Australian Industrial Mining Standard.*

Torquay.—Price Increase.—The T.C. has decided to increase the price of electricity for lighting by 1d. per unit, and for other purposes by ½d. per unit.

Wigan.—At the T.C., reference was made to the steady increase in the demand for electrical energy, and Councillor Alstead said he hoped the Committee would take immediate steps to get a sufficient amount of generating plant—nothing less than 100 million units; if they went up to 200 million units they would be able to sell them.

Wolverhampton.—Price Increase.—The Council has decided that from and after the March readings of the meters the following increases shall be made in the charges for electrical energy:—Ordinary consumers not under contract, and paying over 1d. per unit, a further 30 per cent. increase, making a total of 50 per cent. increase over pre-war charges; ordinary consumers not under contract, and paying 1d. per unit and under, a further 20 per cent. increase, making a total of 50 per cent. increase over pre-war charges.

Worcester.—War Bonus.—The City Council had before it, at its last meeting, the award of Sir G. R. Askwith stating that all plain-time-working employés in generating stations should receive a bonus of 12½ per cent. Mr. Hill, in moving that the increase be given, stated that it would mean an advance at the rate of £606 per annum. In addition, overtime money would have to be paid. The increase, with the advances already granted, would mean a total charge of £2,100 per annum in the department's wages list. The resolution was approved.

It was reported that the annual increased cost of production of electricity was £7,000. The Committee asked for authority further to increase the price of energy supplied to those establishments with whom it had contracts by ½d. per unit, which would produce £1,000.

Workington.—Prov. Order.—It was reported to the T.C., on March 5th, that no opposition had been filed to the prov. order for electricity supply, and it was decided to go forward with the application.

York.—Price Increase.—The T.C. has decided to increase the charges for electricity by 33⅓ per cent. above pre-war rates, as from April 1st next, and to confer with large consumers as to an increase in the charges under contracts.

TRAMWAY AND RAILWAY NOTES.

Accrington.—At the T.C., Alderman Higham reported that the Tramways Committee had come to an arrangement with the Haslingden Corporation respecting the charges made by the Accrington authority for the use of its cars in the Haslingden area. The Accrington formula showed a difference of about £200 in its favour, as compared with the formula submitted by Haslingden, and this was the amount in dispute. Rather than involve themselves in costly arbitration and delays, it had been decided to divide the difference, two-thirds falling upon Accrington and one-third upon Haslingden.

Birmingham.—Wages Award.—The award of the Arbitrators of the Committee on Production with regard to the application by the Corporation employés in the gas, water, and tramway departments for the payment of 12½ per cent. bonus, has been received. It makes the award to the operatives in the gas and water departments, but excludes the motormen and conductors on the tramways.

Bolton.—Electric Vehicle.—The Cleansing and Sewage Committee has decided on the purchase of an electric motor wagon.

Bootle.—At the Town Council meeting, last week, Mr. F. W. King drew attention to the new agreement for the Bootle tramways just entered into with Liverpool, and remarked that in one item, for which they had accepted £41 per mile, there was going to be a loss to the Corporation of £365 this year, whilst next year the loss would be £326. This would come out of the Corporation's £560, reducing it to £135 this year and to £174 next year. He did not think there was much cause for congratulation.

Darlington.—At a meeting of the Town Council, on Thursday, last week, Ald. Sir Charles Starmer moved the adoption of the Electricity and Light Railway Committee's minutes, and said that there would be an increase in the revenue of the light railway department of considerably over £2,000 on the year, and he hoped that it would increase to £3,000 before the year closed. Increases in bonus had been granted to men, women and girls of the department.

Glasgow.—Year's Working.—The returns of the Corporation Tramways Department bring the figures up to March 2nd, the year beginning on June 1st, 1917. For that period the receipts total £1,039,334, as compared with £922,753 in the corresponding period of last year, an increase of £116,681. The number of passengers carried was 319,213,392, as against 288,402,417, an increase of 30,810,975.

Hull.—With reference to the notice that appeared in our last issue, this was based on a circular issued some time ago. It is only intended to relate to correspondence for the department of the tramway electrical engineer (Mr. J. Wilkinson), and *not* to all communications for the tramway department.

Liverpool.—Revision of Fares.—The Finance Committee recently recommended that the Tramways Committee be instructed to prepare a scheme for the revision of fares. Sir Charles Petrie contended that the Council was justified in asking that this should be done, in view of the enormous cost of running and maintaining the tramways. He estimated the extra cost this year as not less than £100,000. If the Corporation carried people the first two miles for 1d., and shortened the more distant stages, it was estimated that £70,000 would be brought in towards the cost of developments and renewals after the war. Councillor H. R. Rathbone said it was not business to hand over large sums of money in relief of rates, and then take back a large portion of it in increased fares. The Finance Committee's recommendation was approved.

Manchester.—At the City Council, Alderman Bowes gave an idea of what war bonuses, &c., were costing the tramway department, affecting about 4,000 employés. At present they were paying in general increases £134,780 a year; on the 12½ per cent. basis, £5,283, with a further approximate amount of £37,034. If the London arbitration was in favour of the men, there would be another increase of £94,583, making a full approximate increased amount of £271,679 a year, to which must be added £56,000 paid to dependents of men at the front.

Oldham.—At the meeting of the Tramways Committee last week, the question was asked why men were leaving the Hollinwood depôt, and the reply was that the men were mainly labourers who had gone on munition work at a recently-opened factory, where handy men could command as much as £3 7s. a week. Provided the men left to go on munitions there was nothing to prevent them going, now that leaving certificates had been abolished.

Russia.—The Petrograd tramways ceased running on Saturday last owing to lack of fuel.—*Reuter.*

Plymouth.—The T.C. is again applying to the Board of Trade for sanction to borrow £8,600 for eight new tramcars, explaining that the amount can be raised out of the Corporation sinking fund.

Southport.—Sunday Service.—At a special meeting of the Tramways Committee last week, it was decided to recommend to the T.C. that a Sunday service be run in the whole of the borough. Hitherto, the only Sunday cars run have been those of

the Southport and Birkdale Tramway Co., which system has just been acquired by the Corporation, and which service the Corporation has continued. On two occasions the ratepayers of the town have recorded substantial majorities against Sunday tramcars.

Threatened Tramway Strike.—Terms of Award.—It is officially announced that the Committee on Production, having on Friday last considered a claim made by the National Transport Workers' Federation to the Municipal Tramways Association, the Tramways and Light Railways Association, and the London General Omnibus Co., Ltd., for an advance in wages, decided that the men concerned, aged 18 years and over, and the grades of women, aged 18 years and over, whose terms of employment include an undertaking that they shall be paid the same rates as the grades of men whose places they have filled, should receive such advance as would give £1 a week over the pre-war rates of the grades concerned, payment to be made on the basis of a week of six days or shifts. Women aged 18 years and over not covered by the above decision are to receive an advance of 4s. a week, subject to a maximum of 20s. a week over the pre-war rates of the grades concerned. Girls, boys, and youths under 18 years are to receive such an increase in wages as will give them half the additional advances given by the Committee's award to the men or women, as the case may be, in the same undertaking. The advances are to be first payable on the pay day in the week commencing March 4th. The award does not include women to whom the provisions of the orders made by the Minister of Munitions under the Munitions of War (Amendment) Act, 1916, apply.—*Daily Telegraph.*

The arbitration award to tramway workers, announced on Saturday, will mean an advance of 8s. a week for men and 4s. a week for women in Manchester, Salford, and most Lancashire towns. In Manchester and Salford some 4,000 employés are concerned, and the additional cost to the Manchester Corporation alone will be about £53,000 per annum.

TELEGRAPH AND TELEPHONE NOTES.

Dutch Wireless Station.—It is reported that the Dutch Government has prepared a Bill to authorise expenditure for the establishment of wireless communication between Holland and the Dutch East Indies. It is expected that a period of three months will be occupied in the erection of the station in Holland, while, in the meantime, the existing station in Java will be given an increased capacity. It is said that the Gesellschaft für Drahtlöse Telegraphie "Telefunken" will superintend the work.

France.—The new wireless station recently erected by the French Naval Authorities for communication with the United States, as mentioned in our issue of December 7th, 1917, is said to be the most powerful in existence, and has already transmitted messages as far as Australia; the stations there which received them were unable to reply in like manner, but acknowledged their receipt by cable. The station was completed in six months, in time to assist in the protection of the first convoys of troops from the United States.

Direct communication between Washington and American Army Headquarters in France will be made possible with the completion of a radio station now being built in France by the Navy Department. At the close of the war the station will be taken over by the French Government. The station will cost $2,250,000.—*T. and T. Age.*

Japan.—The Japanese Department of Communications wishes to establish a large new wireless station exclusively for the benefit of the general public, which will develop the same transmission power as that at Funabashi, which belongs to the Japanese Navy. The Department has decided to erect a wireless station in the Ojika Peninsula, Akita Prefecture.—*T. and T. Age.*

Peru.—The new wireless station at Cashendo, Peru, has been opened. The station can communicate with Argentina, Chile, most parts of Brazil, Uruguay, Paraguay, and Bolivia, and has even caught signals from the United States.—*T. and T. Age.*

CONTRACTS OPEN AND CLOSED.

OPEN.

Aberdare.—March 31st. Electricity and Tramways Department. Stores for 12 months. See "Official Notices" February 22nd.

Australia.—Melbourne.—April 5th. Department of the Navy. Motor-driven hydraulic pump.

June 7th. Department of the Navy. Supply and erection of power plant at Garden Island, Sydney. Director of Navy Contracts, Melbourne.

Bolton.—March 18th. Tramways Department. Materials and stores for 12 months. See "Official Notices" March 8th.

Darlington.—March 29th. Electricity Committee. Water-tube boiler, economiser, cooling tower, fan and feed pump. See "Official Notices" to-day.

Eastbourne.—March 25th. Electricity Department. Six or twelve months' supply of pea or slack coal. See "Official Notices" to-day.

Lancaster.—March 18th. Tramways Committee. Supply of uniforms. See "Official Notices" March 8th.

Macclesfield.—March 18th. Cheshire County Asylum. Stores (10). Electrical goods for six or twelve months. Forms from W. G. F. Tingay, Parkside, Macclesfield.

Manchester.—March 27th. Electricity Committee. Supply and laying of 33,000-volt E.H.T. cable. See "Official Notices" March 8th.

CLOSED.

Bradford.—Electricity Committee. Messrs. Ferguson, Pailin & Co., Ltd. Three single-phase reactances for new turbo-generator.

Derby.—T.C. Setting boiler and economiser at the new power station. E. Morley & Sons, £492.

London.—Hammersmith.—Electricity Committee:—
British Electrical Transformer Co.—Four 100-K.V.A. transformers, at £142 each, and six 200-K.V.A. transformers, at £240 each.
Park Royal Engineering Works.—Switchgear, at £27.

In view of the difficulty in obtaining tenders for the various stores and materials required by the Electricity Department, the Committee has instructed the Borough Electrical Engineer to obtain prices for supplies from time to time, such prices to be submitted to the Council.

Newport, Mon.—The Electricity and Tramways Committee recommends the acceptance of the tender of Messrs. Fraser and Chalmers for a 3,750-KW. turbo-alternator set. The alternator is to be supplied by the General Electric Co., Ltd.

Sheffield.—City Council:—
Wellerman Bros., Ltd.—Additional storey to sub-station building, £350.
Staveley Coal and Iron Co., Ltd.—Circulating water discharge pipes at emergency power station.

Stoke-on-Trent.—T.C. Repairs to engine at the Electricity Works. Davey, Paxman & Co., Ltd, £219.

Swansea.—Electricity Committee:—
New Switchgear Construction Co.—Switchgear.
Stanton Ironworks Co., Ltd.—Circulating pipework.

Wolverhampton.—Town Council:—
Callender's Cable and Construction Co., Ltd.—Cables for the 12 months in accordance with the schedule.
Aron Electricity Meter Co., Ltd.—Testing meter set, £71.
Gibbons Bros.—Reconstruction and extension of the coal conveyor plant, £1,363, plus 15 per cent. for contingencies.
The agreement with the Chloride Electrical Co., Ltd., dated December 4th, 1911, for maintenance, &c., of storage battery at the electricity works, is to be varied in accordance with the terms agreed upon by the company and the electrical engineer.

FORTHCOMING EVENTS.

Institution of Mechanical Engineers.—Friday, March 15th. At the Institution of Civil Engineers, Gt. George Street, S.W. At 6 p.m. General meeting.

Junior Institution of Engineers.—Friday, March 15th. At 39, Victoria Street, S.W. At 7.30 p.m. Paper on "Organisation of British Engineering Industry," by Mr. H. R. Summers.
Monday, March 18th. At 7.30 p.m. Paper on "The Mining and Metallurgy of Gold," by Mr. J. W. Wardell.
Friday, March 22nd. At 7.30 p.m. Paper on "Pyrometers and Impact Testing," by Mr. C. E. Foster.
(**Midland Section**).—Friday, March 15th. At the Imperial Hotel, Temple Street, Birmingham. At 7.45 p.m. Paper on "Power Transmission," by Mr. G. H. Ayres.
Friday, March 22nd. At 7.45 p.m. Paper on "Constructional Engineering," by Mr. G. W. Costigan.
(**North Kent Section**).—Saturday, March 16th. At the Dartford Technical Institute. At 7.30 p.m. Paper on "Local Equalisers," by Mr. R. Rankin.

Electro-Harmonic Society.—Friday, March 15th. At 8 p.m. At the Holborn Restaurant (Venetian Chamber). Last Smoking Concert of the Season. Chairman: Mr. C. H. Wordingham, President of the Institution of Electrical Engineers.

Institution of Post Office Electrical Engineers (London Centre).—Monday, March 18th. At 4 p.m. At the Royal Society of Arts, John Street, Adelphi, W.C. Paper on "The Work of a Drawing Office," by Messrs. H. A. Miles and H. J. Mobbs.

Institution of Civil Engineers.—Tuesday, March 19th. At Gt. George Street, Westminster, S.W. At 5.30 p.m. Discussion on "Modern Developments in Gasworks Construction and Practice." Paper on "The Derwent Valley Waterworks," by Mr. E. Sandeman.

Liverpool Engineering Society.—Wednesday, March 20th. At 8 p.m. At the Royal Institution, Colquitt Street. Paper on "Electric Welding," by Mr. T. G. McKay.

Greenock Electrical Society.—Thursday, March 21st. At 7.45 p.m. At 22, West Stewart Street. Paper on "Production of Iron and Steel," by Mr. A. Norwell.

Belfast Association of Engineers.—Thursday, March 21st. At 7.45 p.m. At the Municipal Technical Institute. Paper on "The Panama Canal," by Mr. J. M. Barbour.

Institution of Electrical Engineers.—Thursday, March 21st. At 6 p.m. At the Institution of Civil Engineers, Gt. George Street, S.W. Paper on "The Mechanical Design and Specification of the Turbo-alternator Rotor," by Dr. S. F. Barclay.
(**Birmingham Local Section**).—Wednesday, March 20th. At the University. At 7 p.m. Paper on "The Control of Large Amounts of Power," by Mr. E. B. Wedmore.
(**Students' Section**).—Friday, March 22nd. At 7 p.m. At the City and Guilds (Engineering) College, South Kensington, S.W. Address by the President.

Royal Institution of Great Britain.—Friday, March 22nd. At Albemarle Street, W. At 5.30 p.m. Lecture on "Radiation from System of Electrons," by Prof. Sir J. J. Thomson, President R.S.
Saturday, March 23rd. At 3 p.m. Lecture on "Problems in Atomic Structure," by Prof. Sir J. J. Thomson, President R.S.

NOTES.

Volunteer Notes.—London Army Troops Companies, Volunteer Engineers.—Headquarters: Balderton Street, Grosvenor Square, W. 1.

Orders for the week ending March 23rd, 1918, by Lieut.-Colonel C. B. Clay, V.D., Commanding.

Officer for the Week.—Lieut. C. E. Campbell.

Next for Duty.—Second Lieut. F. Gaywood.

Monday, March 18th.—No. 3 Company, 6.30—8.30. Recruits' Drill, 6.30—8.30. Signalling Section, 6.30—8.30.

Tuesday, March 19th.—Lecture on "Demolitions," at 6.30. Physical Drill and Bayonet Fighting, at 7.30.

Wednesday, March 20th.—No. 1 Company, Entrenchments, &c., 6.30—8.30. Recruits' Drill, 6.30.

Thursday, March 21st.—No. 2 Company, Entrenchments, &c., 6—8. Recruits' Drill, 6.30—8.30. Signalling Section, 6.30—8.30. Ambulance Section, 6.30—8.30.

Friday, March 22nd.—Musketry, 5.30—8.

Saturday, March 23rd.—Knotting, Lashing and Splicing for the whole corps, 2.45—4.45. Musketry, 2.45—4.45.

Special Notice.—All drills will take place at Headquarters, unless otherwise stated.

(By order) Macleod Yearsley, *Capt. and Adjutant.*

Electric Steel at Wigan.—An important new industry for the production of high-grade steel has been started at Wigan. Councillor Alstead, chairman of the New Industries Committee of the Corporation, informed the Town Council, last week, that negotiations had now been completed, and the work would be pushed on with all speed. The new firm will be known as the Wigan Electro-Metallurgical Co., and it will use electricity for the production from British ironstone of high-grade steel, for which this country has hitherto been dependent upon Swedish and Spanish ore. Councillor Alstead said the process had passed the experimental stage, and the project had received the approval of the Treasury. A site near the electricity works will allow for great expansion, and big developments are hoped for.

The Non-Ferrous Metal Industry Act.—The President of the Board of Trade has appointed Sir Dudley S. Smith, K.C. (chairman), Sir H. Elverston, M.P., and Mr. H. I. Mackinder, M.P., as a Committee to examine all applications for licences under this Act, and to report to the Board thereon. A copy of the rules made by the Board under the Act appears in the *London Gazette* for March 8th.

Electric Vehicles in Ipswich.—Mr. Frank Ayton, chief engineer and manager of the Ipswich Corporation electric supply and tramway departments, informs us that a report has been issued by the borough surveyor of Weymouth, on certain information which he has collected from different towns as to their experience with different electric vehicles, in which, by a mistake, he refers to Ipswich as having in use a Ransomes "Orwell"-type three-ton vehicle. The vehicle, however, is one supplied by the General Vehicle Co. before Messrs. Ransomes, Sims & Jefferies had begun to make electric vehicles. Further, in connection with the information given under Ipswich, the borough surveyor in stating that he believed that, where a journey less than 2½ to 3 miles had to be made, the advantage lay with horse haulage, intended that the 2½ to 3 miles should be the complete journey there and back—or, in other words, he considered that horse haulage had the advantage within a radius of 1¼ to 1½ miles. Mr. Ayton adds that the Ipswich Corporation is absolutely satisfied with the results that have been obtained from the vehicle in question.

An Engineering Council.—Employers and employed in the engineering trades of Manchester have formed an Engineering Council, the primary object of which is to provide facilities for personal intercourse between employers and workers and to carry out constructive investigation and study of conditions and problems affecting the industry. It is considered of first importance that the difficulties facing the engineering trade should be discussed on their merits, and not with the object of "making out a case," an attitude which seems unavoidable during negotiations. It is claimed that employers and workers have sufficient interests in common to make joint discussion fruitful, and to lead to a better understanding between both parties.—*Morning Post.*

Tramcar Conductress Complimented.—Mrs. Mabel Innes, the conductress of the tramcar which recently capsized on a dark, foggy morning on a hilly curve near Allerton, Bradford, was called before a meeting of the Corporation Tramways Committee, last week, and, after being complimented, was presented with £5 as a mark of appreciation of her behaviour during the accident and for the advice by which she doubtless saved the passengers from more serious injury than was sustained. Mrs. Innes was complimented by the Coroner and jury at the inquest on the driver.

The Neglect of Science.—Sir Alfred Keogh, on resuming the Rectorship of the Imperial College Union, South Kensington, was accorded an enthusiastic welcome by the Governors and the students. In returning thanks, he said:—"I hold and always have held that in this country, and perhaps in this country alone, administration has been absolutely divorced from science, that the administrator, as a rule, is ignorant of any particular branch of science, that he has, as a rule, no scientific training, and neither thinks nor acts scientifically. I attribute many of our national shortcomings to this fact. If I have accomplished those things which you say I have in my official service, it has been because I have from the first, both in matters of science and of administration, relied entirely upon scientific men and refused to take into my counsels other classes of administrators. To have done so would have been to have given the lie to the principles I have held for so many years."—*The Times.*

Electrical Trades Benevolent Institution.—The appeals which have been made through the electrical Press during the last few months are beginning to make themselves felt. The Electricals of Cardiff put their heads together, and on March 1st arranged a first-class concert, having unearthed latent talent amongst their members. The G.E.C., who have always liberally supported the Benevolent Institution, offered the use of their showroom for the concert to be held in. During the evening appeals were made by Mr. J. Howard Fletcher, M.I.E.E. (chairman of the Western Section of the Institution of Electrical Engineers), and Mr. Chamen, M.I.E.E., resulting in a sum of £23 being collected, promises made for other amounts, and new members joining. Cardiff has now 17 members, which is probably a record for any town outside London. We are given to understand that the Bristol electricals, who are always in friendly rivalry with Cardiff, intend arranging something on similar lines in the near future and "going one better." Will other towns please copy?

The Electrical Theory of Matter.—Sir Oliver Lodge lectured recently at the Birmingham University on certain astronomical problems in relation to the electrical theory of matter. The chief problem dealt with was that known as the "progression of the planetary apses." Modern astronomers had long been aware that the observed progression was due to the perturbations caused in a planet's orbit by the gravitational pull of the other planets. There was a discrepancy in the case of Mercury, which amounted to about 43 seconds of arc in a century. That was the outstanding astronomical puzzle of the ages. If the electrical theory of matter was correct it was demonstrable that a body moving swiftly through the ether developed an extra or spurious momentum which was not subject to gravitational influence. It was that extra momentum, unknown to older physicists, that was the key to the solution. As the amount of the unaccounted-for progression of Mercury's apses was known, and also its orbital velocity, the formula fixed a value for the velocity in a certain direction of the solar-plus-stellar drift, which turned out to be between two and three times the earth's orbital velocity, and applying it to Mars, he got a value—seven seconds in a century—for the unaccounted-for progression of the apses in the case of that planet. When making the calculation he was not aware what the observed unaccounted-for progression in that case was. Prof. Eddington's figure coincided with the result he had theoretically obtained.—*Birmingham Daily Post.*

Coal Control.—An Advisory Committee has been formed by Mr. Guy Calthrop, Coal Controller, to represent the Public Utility Authorities of the County of London, and consists of:—

F. C. McQnown (County of London Electric Supply Co., Ltd.).
J. W. Beauchamp (West Ham Corporation E.S.).
D. Milne Watson (Gas Light and Coke Co.).
A. Stokes, (South Met. Gas Co.).
A. L. C. Fell (L.C.C. Tramways).

Inland Waterways.—On Wednesday last a conference was to be held between the County Purposes Committee of the Corporation of London and the Canal Control Committee, to consider the improved use of our inland waterways. One hundred representatives of municipal Corporations and other local authorities throughout the country were expected to attend.—*Daily Telegraph.*

Educational.—University College, London.—The annual report, which has just been issued, states that whereas in normal times the total number of students, day and evening, amounts to about 2,200, the number last session was 1,240. Whereas the normal fee revenue amounts to between £29,000 and £30,000 a year, the fee revenue last year was only £14,000. The financial position is naturally a difficult one, and it is anticipated that, unless further help from the Treasury is forthcoming, there will be a deficit at the end of the current session of nearly £9,000 on the College establishment account.

The report shows that, while the ordinary activities of the College have been maintained to meet the needs of the students actually in attendance, all available energies have been directed towards war purposes.

The Pro Patria list includes about 2,500 names of past and present members of the College who are taking an active part in one or other of the Services connected with the war. Of these 195 have already fallen. The list of honours and distinctions gained in the war is a long one.

Manchester College of Technology.—Owing to the popular use of the word "School" as an institution for the education of young people, the governing body of the School of Technology has decided to adopt the title of "College" for the well-known School of Technology, which has attained a position in the front rank of University Colleges, forms part of the University of Manchester, and includes upon its staff such distinguished engineers and scientists as Prof. G. G. Stoney, F.R.S., Prof. A. G Green, F.R.S., and Prof. Miles Walker. In the two years before the war the number of matriculated students attending the College increased by 50 per cent., and though the war has drawn away over two-thirds of its students, to-day there are actually more undergraduates than there were in 1912, and the proportion of evening students doing the most advanced work doubled between 1913 and 1916. The Government grant has increased from £11,895 in 1910-11 to £16,646 in 1915-16, and the City Council before the commencement of the war decided to carry out extensions costing £20,000. Special attention is given to research work, which at present is mainly directed to war purposes, and co-operative researches in conjunction with local industries are increasing in number.

Inquiries.—Makers of the "Ideal" ironclad switches and "Hornfibre" are asked for.

Fuel Oil Experiments.—*The Times* understands that large scale tests have been carried out by the Ministry of Munitions in the production of fuel oil by the carbonisation of cannel coal. It is stated that these tests have been very successful, and that they have shown that extraordinarily high yields of fuel oil, ammonia, and other by-products can be obtained by utilising existing gas works retorts under special conditions, which do not involve much additional outlay.

The Electrical Power Engineers' Association.—The Northern Division has now taken offices at 37, Blackfriars Street, Manchester, and in future all business will be dealt with at this address. The Division is making rapid headway, and applications for membership are being received daily from all parts of the area covered by it.

A very successful inaugural meeting of the E.P.E.A. for Leeds and district was held in the Y.M.C.A. Rooms, Albion Place, Leeds, on February 27th. Mr. C. Nelson Hefford, engineer and manager of Leeds Corporation electricity department, was in the chair. The meeting was well attended, there being present about 100 engineers from the district. After opening remarks by the chairman on the advantages of organisation, Messrs. Lunn and Holt, the chairman and assistant hon. secretary respectively of the Northern Division of the E.P.E.A., supported by Mr. Redmayne (of Sheffield) and Mr. Spurr (of Bradford) addressed the meeting on the advantages of joining the Association, and explained its objects and scope.

A resolution to the effect that the meeting should join the E.P.E.A. and form a branch for the Yorkshire area was carried unanimously. The next meeting is to be held on March 27th.

Wages Awards.—The following are among recent decisions given by the Committee on Production and the Special Arbitration Tribunal on cases which have been referred to them by the Ministry of Labour:—

Motormen and Conductors (Birmingham and Midland Tramways Joint Committee).—The motormen and male conductors concerned, aged 18 and over, are to receive 16s. per week over their pre-war wages from January 1st, 1918.

Foremen, Charge Hands, and Electrotechnical Assistants (Messrs. Robert Paul, London).—The men concerned, aged 18 and over, are to receive from first pay in December such further advances as will bring the increases on pre-war rates to 20s. per week.

Electricians (Metropolitan Electric Tramways, Ltd., and London United Tramways, Ltd.).—Plain time-workers are to receive a bonus of 12½ per cent., and piece-workers a bonus of 7½ per cent. on earnings from first pay after January 1st, 1918.

The Committee on Production and the Special Arbitration Tribunal have also made the following awards:—

1. London County Council Employes.—Certain workmen employed in (1) the main drainage, asylums, fire brigade, and tramway services; (2) at Woolwich Ferry and the Thames Tunnels; and (3) in the chief engineer's department (electrical branch) are to receive, in the case of plain time workers, a bonus of 12½ per cent. on earnings, and in the case of piece-workers a bonus of 7½ per cent. on earnings, from the first pay week following February 15th, 1918. The bonus is not to apply to minor officials or to classes of workmen, such as building trade operatives, whose wages have customarily been regulated by movements in the wages of the trades in which workmen of the same classes are ordinarily employed.

2. Birmingham Corporation Employes.—Workpeople, paid at plain time rates, in gas, water, and tramway departments (except motormen, conductors, and other employés on the traffic staff, whose case is reserved for further consideration), these departments being certified under the Munitions of War Act, 1916, are to receive a bonus of 12½ per cent. on earnings from first pay week following February 14th, 1918. The bonus does not apply to classes of workmen, such as building trade operatives, whose wages have customarily been regulated by movements in the wages of the trades in which workmen of the same classes are ordinarily employed.—*The Times.*

Fatality.—William Craig (20), belonging to Sauchie, Stirlingshire, was working an electrically-controlled capstan in Kelliebank Bottle Works, when, it is supposed, he was caught by a coil of the wire rope and thrown over the capstan, where he was subsequently found unconscious. He died a few minutes afterwards.

According to the *Sheffield Independent*, T. H. Jenkinson (47), an electrician's labourer at Messrs. Thomas Firth & Sons, Ltd., Sheffield, was found on Monday, last week, lying dead on the floor of a sub-station near some current transformers (6,000 to 7,000 volts). He had apparently touched the current coil with the handbrush he was holding. Verdict: "Accidental death."

Engineering Training in Australia.—Following on Mr. Harper's scheme, described in our issue of April 20th, 1917, Mr. Guy Allbut, electrical engineer and manager of the Newcastle, N.S.W., municipal electrical undertaking, is taking steps to raise the standard of efficiency of the technical branch of the electric supply department, and to help towards providing better trained men for the future. He has recommended: (*a*) A system of apprenticeship providing for technical training: (*b*) a system of scholarship whereby those boys who respond to the technical and practical training shall be able to gain experience in one or other of the workshops of the best British and American electrical manufacturers.—*Commonwealth Engineer.*

A New Fuel for Motors.—The Paris *Auto* announces the discovery of a new combustible which contains neither petrol, coal gas, nor alcohol, experiments with which have given very favourable results. The new fuel is secured by the distillation of the heavy oils obtained from the chemical distillation of coal, the process being carried out in such a way that all the by-products from its manufacture become available for the preparation of nitro-explosives. It is claimed for the new fuel that it does not foul the cylinders or leave a residue of carbon, and the consumption is stated to be less than that of petrol.

The Sulphuric Acid and Fertiliser Trades.—In the *Board of Trade Journal* for March 7th, the report of the Departmental Committee appointed by the Minister of Munitions to consider the position of the sulphuric acid and fertiliser trades, as affected by the new acid plants which have been erected by the Ministry, is printed. It states that the productive capacity of the country has reached a value far in excess of the pre-war consumption, and this has created a post-war problem of considerable difficulty. The output is likely to be further increased by the smelting in this country of Australian zinc concentrates, which formerly went to Continental works.

The Committee has come to the conclusion that the most promising method of utilising the surplus acid is the manufacture of artificial fertilisers, especially superphosphates, and advocates the adoption of a vigorous agricultural policy in relation to the efficient cultivation of the soil, with an increased use of fertilisers. The formation of a National Association of Sulphuric Acid Manufacturers is recommended, as well as the scrapping of inefficient plant, for which compensation should be paid out of public funds.

Institution and Lecture Notes.—Institution of Electrical Engineers.—A Committee was appointed by the Council, on December 13th, 1917, to consider the question of the supply and prices of fuel oils to electricity supply undertakings, and a deputation from the Committee interviewed the Controller of Munitions Mineral Oil Production, with highly satisfactory results. A Committee of the Diesel Engine Users' Association was formed, on which the Institution is represented by Messrs. A. H. Dykes, W. Fennell, and J. C. Wigham. The Controller also addressed a letter to users of Diesel engines, advising the adoption of tar-oils under licence from the Department, and offering to assist in adapting the engines for this purpose by obtaining priority for the alterations.

A panel of the B.E.S. Sub-Committee on Nomenclature has been formed to draft a list of terms and definitions used in connection with automatic telephones, under the chairmanship of Mr. A. P. Trotter.

The annual meeting of the Western Local Section was held on Monday last. In the absence of Mr. R. Howard Fletcher, Mr. H. I. Rogers presided, and a resolution of condolence with the relatives of the late Mr. Duddell was passed. Mr. E. Basil Wedmore then read his paper on "The Control of Large Amounts of Power," and a discussion followed. The following gentlemen were elected on the Committee for the ensuing session:—Messrs. H. I. Rogers (chairman), A. Ellis (vice-chairman), J. G. Eastwood, W. T. Kerr, A. Nicholls Moore, T. E. Lewis, and I. A. D. Pedler. Messrs. A. J. Newman and C. T. Allan were elected joint hon. secretaries, and Mr. A. J. Newman, hon. treasurer.

The Rontgen Society.—This Society has recently founded an annual lecture in memory of its first president, the late Prof. Silvanus P. Thompson. The first lecture will be delivered by Prof. Sir Ernest Rutherford, F.R.S., at the next meeting of the Society, on Tuesday, April 9th, at 8 p.m. The Council will be pleased to welcome all interested, and applications for cards of admission should be made to the hon. secretary, Dr. S. Russ, Middlesex Hospital, London, W. 1.

At a meeting of the Bradford Textile Society, on Monday evening, Dr. J. F. Crowley, M.I.E.E., was to have lectured on "Some Interesting Applications of Electricity in the Textile Factory," but in view of circumstances arising since the syllabus was arranged, he changed the subject to "Economic Aspects of Industrial Unrest."

Royal Society of Arts.—The paper on "Agricultural Machinery," by Mr. F. S. Courtney, announced for reading before the Society on the 20th inst., has been postponed till April 17th. On Wednesday, March 20th, a paper on "The Food Situation in Germany" will be read by Mr. Percy Shuttlewood, of the Ministry of Food.

To One-Man Business Proprietors.—An Association has recently been formed of those who come under the above-mentioned heading, its objects being to look after the interests of its members both during and after the war. The Association has received the official recognition of the Ministry of National Service. Practically every trade and profession is represented amongst its members. Those interested should apply to the Honorary Secretary, "One-Man Business Association," c/o The Holborn Restaurant, London, W. 1, who will be pleased to forward all particulars regarding the Association.

National Electricity Supply.—We have received from Mr. Andrew Gemmell, "a shareholder and a former secretary of electric power companies," a pamphlet on the reference to the North of England in the Report of the Sub-Committee on Coal Conservation, in which the author argues that the Report is in error in attributing to company ownership lower charges for energy than in the case of municipal control, and adversely criticises the methods of commercial and financial organisation adopted by the companies forming the North-Eastern combination. In particular, he comments on the history of the Cleveland group of companies, the absence of an audit of the business as a whole, and the alleged success of the Waste Heat Co., with regard to the reduction of charges for electric power supply that is called for in the interests of the nation.

On Tuesday last week a debate took place at the Engineers' Club, Manchester, on the Interim Report of the Coal Conservation Sub-Committee on Electric Power Supply. Mr. George Hughes presided, and Mr. S. L. Pearce, chief electrical engineer to the Manchester Corporation, was the principal speaker. A report will appear in our next issue.

Appointments Vacant.—Instructor in electrical engineering and wiring in connection with the training of discharged and disabled sailors and soldiers, for the Barnsley Corporation Electricity Committee; electrical fitters and armature winders, for the Newport Corporation Electricity and Tramways Department; assistant working electrical engineer (55s. + 15 per cent.), for the Ormskirk B. of G.; mains and meter man (50s. + 12½ per cent.), for the Wishaw Burgh Electricity Department; shift engineer (£170) for the Wolverhampton Corporation Electricity Department; charge engineer (£143 + 12½ per cent.) for the Weymouth Corporation Electricity Works; junior shift engineer (£130) for the Borough of Dover Electricity Works; meter superintendent (52s. 6d.) for Loughborough Corporation Electricity Department. See our advertisement pages to-day.

Electrical Cooking.—Mr. William A. Gillott, of the Newcastle Electric Supply Co., Ltd., addressed the members of the Newcastle Rotary Club, last week, on the subject of electrical cooking. He said that from 35,000 to 40,000 meals per week were prepared in Newcastle by electrical apparatus, and schemes were in hand for dealing with 200,000 meals per week. He did not think that, four years ago, there were 500 meals so prepared. Electric cooking was, therefore, a commercial proposition. Speaking of cost, he said that in canteens four or five meals could be cooked at the cost of a penny. He could say, without giving any secrets away, that a certain firm of caterers in the city were shaking hands with themselves over the saving effected by the use of electrical cooking apparatus.—*Newcastle Chronicle.*

Overseas Trade of the Future.—In our leaderette of last week, p. 218, in the course of printers' corrections, a line was accidentally omitted. From line 25 (second column) onwards should read thus:—

"When the new system comes into force the more promising Consuls will be eligible as Commercial Attachés after passing through specified progressive grades. It will be the work of the Commercial Attachés to collect information," and so on.

Babcock & Wilcox in Spain.—The *Times* Madrid correspondent states that an agreement has been concluded between Messrs. Babcock & Wilcox and a group of influential Bilbao capitalists for the establishment of engineering works in that city, which will be by far the largest of their kind in Spain. A company has been formed, entitled the Sociedad Espanola de Construcciones Babcock & Wilcox. It has been formed under the new Spanish law for the stimulation of national industry, by which the Government guarantees payment of 5 per cent. interest on the capital paid up should the net profits of the company fall below that percentage. The capital has been fixed at 24 million pesetas, approximately 1 million sterling, and 20 millions have been issued and subscribed. The object of the company will be to manufacture Babcock & Wilcox marine boilers and engines for vessels built in Spain, stationary and other boilers, electric cranes and conveying machines, drawn steel tubes, and also locomotives of the type used in Spain and Portugal, which formerly were all brought from Germany. The works of the company will cover about 30 acres, and will give employment to about 2,500 men.

The B.E.A.M.A.—The annual general meeting of the British Electrical and Allied Manufacturers' Association was held on February 28th. The report for the year ended September 30th, 1917, was adopted. On ballot the following were elected to fill the five vacancies on the Council:—British Electric Transformer Co., Ltd.; Browett, Lindley & Co., Ltd.; Mather & Platt, Ltd.; C. A. Parsons & Co., Ltd.; and Yates & Thom, Ltd. The chairman mentioned in the course of his remarks that the articles of association had been entirely recast, and the B.E.A.M.A. was now an Association for Manufacturers exclusively, the classes of "Associate Member" and "Associate," consisting chiefly of factors, having been cut out. We shall refer more fully to the report and meeting in our next issue.

Street Lighting Specifications.—The Standard Clauses for Street Lighting Specifications recommended in the Majority Report of the Street Lighting Specification Committee (see *Journal* I.E.E., 1917, Vol. LV, page 522) have been published in pamphlet form. Copies can be obtained from the Secretary of the Institution, price 3d. each, or 4d. post-free.

Electricity and Agriculture.—Writing to *The Times*, Dr. Chas. Mercier states that while the electrification of growing crops is "in the experimental stage," the electrification of seed before sowing has been proved to be highly beneficial; farmers who tried the process on a small scale have successively increased their operations, and this year hundreds of acres in the county of Dorset are being sown with electrified seed.

Prof. Henry Armstrong and Dr. J. Crichton-Browne have written questioning the facts and deprecating the use of electrical treatment on a commercial scale until its efficacy has been demonstrated and the "effects have been accurately defined and gauged." We have not heard that the Admiralty have deferred the use of new inventions for the solution of the submarine problem until their effects have been accurately measured to the satisfaction of the professors, who seem to leave the emergencies of war-time out of their calculations. Now is the time to act, and to adopt every possible device which offers any prospect of increasing our supply of food; there will be plenty of time for accurate measurement when we have attained the victory which is essential to our existence as an Empire, or even a free nation. We are glad to see that Prof. Sir Oliver Lodge, in a letter to *The Times*, declares that the use of the electric discharge over growing crops passed the laboratory stage some time ago, and "has given practical results for some years."

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the Electrical Review *posted as to their movements.*

Central Station and Tramway Officials.—At a special private meeting of the York City Council, at which proposed increases of salaries to officials in all departments were discussed at length, it was decided that the increases in respect of the salaries of the engineers in the electricity department, who recently received a £50 advance, be referred back to the Electricity Committee to consider in conjunction with the proposed increases of the Askwith award, standing orders to be suspended to enable the question to be dealt with at a later Council meeting. The application of the Askwith award to the city electrical engineer was referred back for further information. It was resolved to increase the salary of the draughtsman in the electricity department by £10 to £140, and for several clerical assistants advances of £5, £3, and thereabouts were approved.

The Hove Lighting Committee has resolved to advance the salary of Mr. C. B. Smith, the electrical engineer, by £100 per annum. Mr. Smith has acted as engineer since the inception of the old company in 1892, and was retained by the Corporation when it took over the undertaking in 1914 as engineer at the same salary as that paid him by the company, viz., £650 per annum.

Lieutenant R. L. Acland has been gazetted Major Commanding the Derbyshire Motor Volunteer Corps. Major Acland is borough electrical engineer and tramways manager, Chesterfield.

The technical engineering staff of the Dublin Corporation electrical department presented Mr. J. J. O'Neill with an illuminated address and a gold watch in appreciation of his work as chairman of the Electricity Supply Committee during the past four years. Mr. L. J. Kettle, deputy city electrical engineer, who performed the ceremony, said it was no easy matter to reconcile the multiplicity of interests involved in the huge electrical undertaking and to do justice to the staff and the enterprise, but Mr. O'Neill could fairly claim to have achieved success. Mr. O'Neill, in acknowledgment, spoke of the good relationship which had been maintained between the Committee and the staff, and expressed his belief that in the near future the electrical undertaking would be one of Dublin's greatest assets, and that before many years fault-finding would have to make way for honest appreciation of what had been done, and was being done, on behalf of the citizens.

Mr. Herbert Pollard, engineer-in-charge to the Rochdale Corporation electricity department, has been appointed engineer-in-charge to the Keighley Corporation.

At the Plymouth T.C. it was reported that Mr. Everson's appointment as tramways manager would expire on August 8th, and it was decided that the appointment be continued until November 8th, 1919, at £600 per annum and house.

The salary of Mr. R. H. Campion, eletcrical engineer to the Dewsbury Corporation, has been advanced by £25 per year. The salary of the assistant engineer has been advanced £20, and the Electricity Committee has resolved that the award of 12½ per cent. bonus on earnings shall apply to all employés at the works who have received the full bonus awards up to date.

At a meeting of the Bolton T.C., last week, it was decided to increase the salary of the electrical engineer, Mr. W. J. Wood, from £600 to £800 per annum. It was stated that Mr. Wood had spent £125,000 on improvements at the Back-o'-th'-Bank generating station, and had asked for no special assistance.

Dover T.C. has appointed Mr. Harpur, mains superintendent, to succeed Mr. Woodman as electrical engineer, at a salary of £300 a year and house, and Mr. Smith, works superintendent, as chief assistant electrical engineer at £275 a year.

Mr. G. Roddy, traffic manager of the Rhondda Tramways, having been appointed Divisional Inspector for South Wales and Monmouthshire under the Ministry of Food, is to receive a presentation from his friends at Porth on March 22nd.

Presentations have been made to Mr. Albert Mackrill, chief clerk in the Hull tramways electrical engineer's office. He is leaving Hull after 18 years' service with the Corporation to take up an appointment at Stoke-on-Trent as commercial manager to the borough electrical engineer. He was presented with a portion of a silver dinner service by Mr. Wilkinson, subscribed for by the employés. Mr. Elliott, chief mechanical engineer, and Mr. Bruce, chief assistant engineer, followed with appropriate remarks, and Mr. Mackrill responded. As a personal token of appreciation, Mr. Wilkinson handed Mr. Mackrill a gold English lever watch.

Exeter City Council, on Tuesday, approved the Electricity Committee's recommendation to advance the salary of the electrical engineer, Mr. H. D. Munro, from £475 to £550.

General.—Mr. C. H. Wordingham, M.Inst.C.E., whose official title under the Admiralty has hitherto been Superintending Electrical Engineer, will in future be known as Director of Electrical Engineering, and his department will no longer be attached to that of the Director of Naval Construction, but be entirely separate and self-contained.

Mr. H. A. Vernet, who has been appointed Paper Controller, is a director of the Underground Electric Railways Co. and the Metropolitan District Railway, and is also chairman of the Traction & Power Securities Co.

Monsieur J. A. Montpellier, who for many years was editor of our contemporary *l'Electricien*, which in August, 1914, suspended operations for the period of the war, has become editor of *l'Industrie Electrique* as from March 1st. M. Montpellier has rendered important services in connection with the Military Telegraph Service at Paris during the war. He has the best wishes of his electrical and journalistic confrères in this country on his return to the editorial chair.

Mr. Harold W. Smith, electrical engineer with the Australian Commonwealth Department of Works and Railways, has accepted a position with the Westinghouse Co., Pittsburg, U.S.A. Mr. E. C. Creasey has been appointed engineer-in-charge of the Corowa, N.S.W., municipal electric supply.—*Commonwealth Engineer.*

Mr. Sydney Dicks, late senior representative of the Union Cable Co., Ltd., of Dagenham, has now joined the Enterprise Manufacturing Co., Ltd., as a director.

Mr. Howard Foulds, secretary of Callender's Cable and Construction Co., Ltd., and other companies, has been elected a member of the Council of the Chartered Institute of Secretaries.

The marriage took place yesterday, at Bath, of Lieutenant Christopher Wade, M.T., A.S.C., youngest son of the late Mr. J. E. Wade, of Brantingham Thorpe, and the late Mrs. Wade, of Kirkella Hall, East Yorks, and Alice Dorothea Evelyn, younger daughter of the late Major-General Henry Evelyn Coningham, Madras Staff Corps, and Mrs. Coningham, of Sydney Place, Bath.

Roll of Honour.—Lieutenant A. M'Auslan, R.F.A., formerly on the staff of the electrical department at Messrs. Harland & Wolff's shipyard at Irvine, has been awarded the Military Cross.

Lance-Corporal A. Gunn, of Polmadie, Scotland, formerly in charge of the electric power station at Aitkenhead Colliery, Mount Florida, has been awarded the Military Medal.

Private H. Featherston, of the King's (Liverpool Regiment), killed in action, was employed by the British Westinghouse Co. at Trafford Park.

Artificer W. Howarth, an electrician who lost his life on board a vessel which was recently torpedoed, was employed by Messrs. Richard Haworth & Sons, Ltd., Salford.

Lance-Corporal G. Allen, Loyal North Lancashire Regiment, previously posted missing, now reported killed, aged 24, was an electrical engineer with Messrs. Heywoods, Ltd., Manchester.

Driver J. W. Seddon, R.F.A., who has died from wounds, was an employé of the Lancashire Dynamo & Motor Co., Ltd., Trafford Park.

Gunner H. Savage, R.E., awarded the Military Medal for gallantry in the field by mending wire under heavy shell fire, was a former employé of Messrs. Dick, Kerr & Co., Ltd., Preston.

Second-Lieutenant J. R. Beckton, R.E., who has fallen in action, aged 28 years, was on the staff of Messrs. Crompton and Co., Ltd., of Chelmsford.

Captain Frank Hiley, Yorkshire Regiment, who has been accidentally killed in Italy, aged 23 years, was an electrical engineer at Hemsworth Colliery.

Obituary.—Mr. R. W. Hornsby.—The *Times* contains a notice to the effect that Mr. Richard William Hornsby, late of St. Vincent's, Grantham, passed away on March 7th at 71, Queen's Gate, after a long illness.

CITY NOTES.

Westminster Electric Supply Corpn., Ltd.

Mr. J. Browne Martin presided at the annual meeting on February 27th. He said that the receipts for 1917 were in excess of those for 1916, owing mainly to the power and heating units having increased by 3,750,000. For the first time in their history current used for these purposes exceeded that for lighting. Costs of generation compared very favourably with the previous year. The difficulty of obtaining new machinery was one which, even after the war, would continue for some time. This had prevented them from shutting down two of their older stations, containing old and inefficient machines, as they would have done under different circumstances. The tendency was for coal to rise still higher in price. It had cost £12,000 more than in 1916, and they consumed 7,100 more tons. Increased wages and war bonuses bore materially upon production costs, and it was impossible to forecast the future in this connection. Costs of distribution continued to increase, owing mainly to cost of materials. Several Government Committees had been inquiring into "after the war" conditions, and the subjects discussed included the supply of electricity. So far, no practical conclusions had been arrived at. They had an increase of 0.15d. per unit in current supplied for power and heating, but lighting current remained as in 1916 (10 per cent. above pre-war rates). Captain E. I. Bax said that owing to the restricted allowances of coal to householders, they had been almost inundated by demands for heating, and had not been able to supply everybody who had asked for it owing to the difficulties attending new services, and to their feeling obliged to keep in reserve sufficient machinery to supply the great calls for all the new Government offices that were growing up all around them. Their consumers now included about 2,300 who among them were using about 6,000 electric fires. There would be an enormous extension in this department when normal conditions prevailed.

Metropolitan Electric Supply Co., Ltd.

Mr. A. W. Tait, presiding at the annual meeting on Monday, said that the satisfactory increase of 15 per cent. in gross revenue was partly accounted for by the increased charges to consumers, and the greater part of it related to power supply. Progress in the western area, which contained their largest power consumers, had been satisfactory, and only limited by the capacity of the plant and mains. The Government informed the supply companies that the Ministry of Munitions' 12½ per cent. award did not apply to their electrical workers, but a strike was threatened, and Sir George Askwith held arbitration proceedings, with the result that he granted the 12½ per cent. to all men in the employment of the London companies as from October, 1917, and, in addition, a further 5s. per week was made applicable to them in consequence of pressure put upon the companies. Their case could not be properly submitted, as they were not invited to attend until after the proceedings had commenced. The retrospective charge was imposed notwithstanding that it was pointed out that it was impossible for the companies to recover any portion of the same from their consumers until some time had elapsed. The accounts, therefore, had suffered to the extent to which these charges had to be met up to December last. To their company it meant not less than £10,000 per annum, apart from increases to the staff. It would be necessary to make some further adjustment of charges to consumers in order to recover a portion of the additional cost. The directors were pleased to be able to recommend an increase in the dividend, especially as it was accompanied by a substantial increase in the amount set aside to the depreciation and reserve fund. He hoped that when the war was over, if not before, the electricity supply companies would seriously consider some plan of amalgamation of interests. The salvation of the situation, and the proper development of supply in London, lay in that direction.

County of London Electric Supply Co., Ltd.—Capital expended on account of the company's London districts during 1917 was £45,124. Revenue, after deducting expenses, was £153,496, plus £18,378 brought forward. Debenture and loan interest absorb £43,476, £50,000 is put to reserve for depreciation, and after paying the preference dividend, and 7 per cent., less tax, on the ordinary shares for the year, £15,023 is to be carried forward. Applications received during the year were 4,551 KW., making the total 69,132 KW. Units sold were 37,595,261, an increase of 2,565,399. Consumers increased from 26,994 to 27,998. In view of cost of coal, wages, and material, and the abnormal conditions, the results are satisfactory. Coatbridge & Airdrie Electric Supply Co., Ltd., made further progress, units sold increasing from 8,414,823 to 10,072,535.

Callender's Cable & Construction Co., Ltd.—The directors propose to issue to the ordinary shareholders a new ordinary share in addition to each share held, and to subdivide both the preference and ordinary shares (£5 each) into denominations of £1 each. In order to do this the authorised share capital is to be raised from £500,000 to £700,000. After providing for the distribution as above, £150,000 in share capital will remain unissued. Treasury consent is being sought. The directors propose the foregoing course as a measure for bringing the nominal issued capital more into accord with the actual funds invested in the business. A surplus has been accumulated, apart from the reserve, which exceeds the total issued ordinary share capital.

Direct Spanish Telegraph Co., Ltd.—Dividends for the half-year ended December at the rate of 10 per cent. per annum, less tax, on the preference shares, and at the rate of 6 per cent. per annum, free of tax, on the ordinary, making 5 per cent. for the year, also a bonus of 2 per cent., free of tax, on the ordinary.

Charing Cross & City Electricity Supply Co., Ltd.—The net earnings of the West-End undertaking fell from £71,642 in 1916 to £61,869 in 1917. Dividend on the ordinary shares, 4 per cent. for the year. The net earnings of the City undertaking fell from £65,555 to £65,388.

Western Telegraph Co., Ltd.—Quarterly dividend, 3s. per share, free of tax.

Canadian General Electric Co., Ltd.—Dividend of 2 per cent. on the common stock for March quarter.

Newcastle-upon-Tyne Electric Supply Co., Ltd.—Connections increased during 1917 by 14,329 H.P. to 297,079 H.P. Profit, exclusive of renewals or plant improvements, was £309,779, against £263,957 for 1916. £60,000 (as against £39,691) is deducted for reserve for plant renewals and improvements. Debenture and loan interest amounts to £60,606, and there is transferred to reserve for special depreciation and contingencies other than the equalisation of dividends £60,000. After paying 5 per cent. on the preference shares and 8 per cent. on the ordinary, £8,468 is to be carried forward. The general reserve account has been amalgamated with the reserve for depreciation, and is known as "Reserve for Special Depreciation and Contingencies other than the equalisation of dividends." A new account has also been opened under the head of "Reserve for plant renewals and improvements." The reasons for these changes are to be given at the annual meeting on March 21st. The additional capital expenditure for 1917 was £202,647, representing further extensions at Carville and Dunston power stations, and of mains, &c. In order to be in a position to meet further developments, when necessary, it is desirable that the preference and ordinary capital should be increased to £1,500,000 respectively. The matter will be submitted at an extraordinary general meeting on 21st inst. Mr. H. W. F. Bolckow has been appointed a director.

Northampton Electric Light & Power Co., Ltd.—At the annual meeting, on March 7th, Mr. F. H. Thornton said that the chief feature of the year had been the gradual erection of the new riverside generating station. Owing to difficulties which war conditions placed in the way of obtaining material, especially steel and iron, progress had not been so great as had been hoped for, but where a year ago there were only the foundations, there was now a very substantially-built works, which it was expected would be available in the autumn of this year. More than two miles of high-tension mains had been laid during the year; units sold had increased 11 per cent., and revenue from the sale of current 25 per cent.; while the depreciation account had been increased by £6,450. The cost of coal was £3,858 more than last year, and in this connection Mr. Thornton commented on the action of the Government in making the 2s. 6d. extra per ton imposed in October retrospective over the preceding month. That cost the company £1,000, which they were unable to recover, and the conduct of the Government was most unbusinesslike. A dividend of 8 per cent. for the half-year on the ordinary shares, making 6½ per cent. for the year, was approved.

City of London Electric Lighting Co., Ltd.—Capital expenditure during 1917, £5,839. Written off in respect of buildings, plant, and other works dismantled during 1917, £29,372. Revenue for the year £351,186, expenses £209,525, leaving £141,661, plus £17,132 brought forward. Interest on loans and debenture stock £27,241, reserve £50,000, preference dividend 6 per cent., ordinary dividend 8 per cent., carry-forward £17,573. The gross revenue increased by £18,250 to £351,186, and the net revenue by £7,861 to £141,640. The average price obtained per unit sold rose from 2.51d. to 2.61d. Consumers increased by 42 to 14,658, and KW. connected by 1,748 to 49,079. Units generated increased from 33,758,872 to 35,375,929; units sold from 28,982,456 to 29,697,392; total maximum supply demanded rose from 19,198 KW. to 20,910 KW. Power units sold 11,416,597; heating units sold 4,433,031; together 55.37 per cent. of the total sold for private supply. Annual meeting: March 20th.

Kensington & Knightsbridge Electric Lighting Co., Ltd.—The number of houses and shops increased during 1917 by 40 to 5,110, and the equivalent of 30-watt lamps added was 35,449, making 557,624 (16,728 KW.). The units sold increased by 494,522 (10.5 per cent.). The net profit was £13,225, plus £205 brought forward. After paying the preference dividends, and 7 per cent. for the year on the ordinary shares, £580 is to be carried forward. The renewal and reserve account now stands at £141,425. It is proposed to grant an annuity of £100 per annum during his life to a gentleman who has served the company for many years, but is now entirely incapacitated by illness. Meeting: March 21st.

Rushden & District Electric Supply Co., Ltd.—Mr. F. H. Thornton, chairman, said at the annual meeting that the real difficulty of the year had been to obtain fuel and other materials. The cost of fuel had increased by 56 per cent., and this had necessitated increased charges for current. A good many people were asking the company to make extensions, and as soon as they could obtain the permission of the Ministry of Munitions they would do their best to meet the requests, as they anticipated a successful future at Rushden.

Oxford Electric Co., Ltd.—Sir Henry Mance, presiding at the annual meeting last week, referred to the loss of revenue from which the company suffered owing to the continued restriction of public lighting and shop lighting. Canvassing in new districts was practically useless, as it was impossible to obtain a permit for the necessary materials. Should they—he did not think they would—come within the scope of a national electric supply scheme after the war, there was no reason why it should not benefit the company as well as the public.

Bournemouth & Poole Electricity Supply Co., Ltd.—Including £2,265 brought forward, the available balance, after paying expenses, is £38,120. Debenture and other interest, &c., require £10,885, and £8,000 is put to depreciation reserve. After paying the preference dividends, and 6 per cent. on the ordinary, less tax, £2,079 is to be carried forward. Applications received amounted to 12,171 KW., an increase of 712 KW. Units sold for all purposes were 4,834,988. Annual meeting held yesterday, in London.

Stewarts & Lloyds, Ltd.—Dividend on the preferred ordinary shares for the past half-year at the rate of 10 per cent. per annum; 2s. per share and a bonus of 6d. per share on the deferred ordinary; £100,000 for depreciation and excess profits duty; £100,000 to reserve; £20,000 to employés' benefit reserve; carried forward £100,000.

Melton Mowbray Electric Light Co., Ltd.—Revenue for 1917, including £395 brought forward, £2,350. Dividend on the ordinary shares, 2 per cent. per annum; debenture interest, £955; reserve for renewals, £800; carry forward, £195. At the annual meeting, Mr. W. J. New said that the profits had been affected by increased cost all round. Charges to consumers had been raised.

W. T. Glover & Co., Ltd.—Dividend on ordinary shares for 1917, 5 per cent., and a bonus of 2½ per cent. Debenture redemption £6,500, reserve £20,000, carrying forward, subject to excess profits duty, £10,770.

STOCKS AND SHARES.

Tuesday Evening.

The effect of the intensified War Bond campaign has not yet entirely spent itself in the Stock Exchange markets. Business continues to go quietly, and it is evident that a good deal of the stock which was turned out last week to provide the wherewithal to buy War Bonds and War Savings Certificates, has yet to find permanent homes. So long as this influence is apparent, there is not likely to be any marked revival in Stock Exchange business, but that there is a good deal of money about in the provinces the buying orders from the various centres, especially those of Scotland, South Wales, and Yorkshire, amply witness. The purely investment markets are those most nearly affected by the aftermath of the War Bond campaign, and some people ask whether the latter, successful though it was, has provided sufficient money for the war to carry on without recourse to further borrowing in addition to the present War Bonds. Industrials continue to absorb most of the public's attention, while a certain amount of speculative interest has revived in base-metal shares.

The meeting of the Underground Electric Railways Co. passed off last Friday without particular incident, and those who went there in the expectation of a breeze came away somewhat disappointed. The chairman dwelt upon the various difficulties with which the company is faced, but added little new to the general stock of information, probably because there was little new to add. A revision of fares is now generally looked for, while those who have the good fortune to be workmen or season-ticket holders (or both) can afford to smile at the prospect of continuing to travel afoot in the company's trains, and at the present scale of charges. Metropolitan ordinary stock has weakened to 21, Districts are dull at 14¼, but Underground incomes rallied to 80, and the 6 per cent. income debenture stock to 100½ xd.

The County of London Electric Supply report makes satisfactory reading to the shareholders. A dividend at the rate of 9 per cent., making 7 per cent. for the year, is declared, this being at the same rate as last year's. The total number of units sold showed an increase of 2½ millions, and there were about 1,000 extra consumers. No change has occurred in the price. City Lights, however, are ½ down, and Charing Cross weakened to 3¼, although the preference at 3½ are 5s. to the good.

The Kensington & Knightsbridge Electric accounts show an increase in the net profits of £16,000, which is sufficient to raise the dividend from 6 per cent. to 7 per cent., the carry-forward being slightly increased at the same time. These results, in conjunction with those upon which we commented last week, have had little effect on the market for the time, but they are likely to prove more potent when the investor's attention turns again to this department. At present, he is occupied with other matters, and, therefore, ignores the ample yields afforded by electric lighting shares, though it is necessary to hasten to add that his scope is limited in consequence of the shortage of shares on offer in the market.

Metropolitan Electric Ordinary have risen 5s. to 3½ in consequence of the dividend being raised from 3 per cent. to 4 per cent. At the meeting the other day, the chairman said he hoped that when the war was over, if it was impossible to do so before then, the electric supply companies would seriously consider some plan of amalgamation of interests. He was more than ever convinced that the salvation of the situation, and the proper development of the supply of electricity within the London area, lay in that direction.

The telegraph market is steady, and Westerns at 15¼ are 7s. 6d. up, although, on the other hand, Eastern Ordinary at 151½ has shed a point. There is not much doing in this section. Marconis have come in for more attention than usual, and the price of the parent shares in consequence improved ½ to 3 3/16, while the preference advanced to 2 11/16. American Marconis are also better at 25s. Oriental Telephones at 4 3/16 have recovered 1/16.

The big rises recently secured by Callender's and Henley's have brought in a few sellers, with the result that Callenders at 17½ and Henleys at 19½ are 5s. and 10s. lower respectively. Business marked early this week in Callenders at 17½. General Electrics have changed hands lately at 19¾ and 19 9/16, a transaction being marked in the preference at 10⅞, the middle price. India-Rubber shares keep consistently firm, and on top of their previous improvements show a further rise of 12s. 6d. at 15½, shares changing hands on Monday at 15¼. Babcock & Wilcox rose 3/16 to 3¼ on the expectation of a bonus being declared with the next dividend, and other shares of the engineering, iron, and steel groups are generally strong. The electric manufacturing shares are just steady, activity having died down to some extent, although prices are well maintained.

The course of the rubber market runs mostly on the downward grade. The imminence of the Budget affords another reason for dulness in this section, on account of the fear that the Excess Profits Tax may be advanced. Amongst the base-metal groups, tin shares make the best showing, although there is a fairly brisk demand for those of the iron and steel companies. The armament market is somewhat irregular in tendency.

SHARE LIST OF ELECTRICAL COMPANIES.

	Dividend 1915.	Dividend 1916.	Price March 12, 1918.	Rise or fall this week.	Yield p.c.
Home Electricity Companies.					
Brompton Ordinary	10	9	6¾	—	£6 18 6
Charing Cross Ordinary	6	5	3⅞	— ¼	6 13 4
do. do. do. 4½ Pref.	4½	4½	3½	+ ¼	6 18 6
Chelsea	4	3	3	—	5 4 4
City of London	8	8	12⅝	— ⅛	6 4 3
do. do. 6 per cent. Pref.	6	6	10½	—	5 18 6
County of London	7	7	11⅛	—	6 6 0
do. 6 per cent. Pref.	6	6	10½	—	5 18 5
Kensington Ordinary	7	6	8¾	—	6 10 3
London Electric	3	Nil	1½	—	Nil
do. do. 6 per cent. Pref.	6	4	3¼	—	8 0 0
Metropolitan	3	3	2⅝	+ ¼	5 14 4
do. 4½ per cent. Pref.	4½	4½	3⅝	—	6 13 4
St. James' and Pall Mall	8	8	7⅛	—	6 6 4
South London	5	5	3	—	6 13 4
South Metropolitan Pref.	7	7	21/-	—	6 13 4
Westminster Ordinary	7	7	6¾	—	6 13 4
Telegraphs and Telephones.					
Anglo-Am. Tel. Pref.	6	6	94½	—	6 7 0
do. Def.	33/6	1½	19⅜	—	6 13 4
Chile Telephone	8	8	7½	—	5 10 4
Cuba Sub. Ord.	5	7	9½	—	*7 11 4
Eastern Extension	8	8	15⅝	—	*5 6 0
Eastern Tel. Ord.	8	8	151½	—1	*5 5 7
Globe Tel. and T. Ord.	7	7	14½	—	*4 18 3
do. Pref.	6	6	10⅝	—	5 18 5
Great Northern Tel.	22	24	36	—	6 11 6
Indo-European	13	13	51½	—	6 6 3
Marconi	10	15	3 3/16	+ ⅛	4 14 3
Oriental Telephone Ord.	10	10	4 3/16	+ 1/16	2 17 2
United R. Plate Tel.	8	8	6⅛	—	*5 17 4
West India and Pan.	6d.	6d.	1½	—	*2 19 2
Western Telegraph	7	8	15½	+ ¼	*5 2 5
Home Rails.					
Central London, Ord. Assented	4	4	63½	—	6 9 1
Metropolitan	1	1	21	—	4 15 3
do. District	Nil	Nil	14½	— ½	Nil
Underground Electric Ordinary	Nil	Nil	1½	—	Nil
do. do. "A"	Nil	Nil	5/-	—	Nil
do. do. Income	6	4	80	+ ½	*5 0 0
Foreign Trams, &c.					
Adelaide Sup. 6 per cent. Pref.	6	6	4⅞	—	6 3 1
Anglo-Arg. Trams, First Pref.	5½	5½	2⅞	—	—
do. 2nd Pref.	5½	—	2½	—	—
do. 5 Deb.	5	5	66½	—	7 10 6
Brazil Tractions	4	4	44½	— ½	—
Bombay Electric Pref.	6	6	9½	—	6 6 4
British Columbia Elec. Rly. Pfce.	5	5	53	—	9 8 8
do. do. Preferred	Nil	Nil	31½	—	Nil
do. do. Deferred	Nil	Nil	28	—	Nil
do. do. Deb.	4½	4½	60	—	7 1 7
Mexico Trams 5 per cent. Bonds	Nil	Nil	37	—	Nil
do. 6 per cent. Bonds	Nil	Nil	32½	—	Nil
Mexican Light Common	Nil	Nil	17½	—	Nil
do. Pref.	Nil	Nil	29	—	Nil
do. 1st Bonds	Nil	Nil	38	—	—
Manufacturing Companies.					
Babcock & Wilcox	15	15	3¼	+ 3/16	4 5 9
British Aluminium Ord.	7	10	1¼	—	6 0 9
British Insulated Ord.	17½	20	30	—	5 6 8
British Westinghouse Pref.	7½	7½	2⅞	—	5 2 0
Callenders	20	20	17½	— ½	5 16 0
do. 5 Pref.	5	5	4	—	6 5 0
Castner-Kellner	22	20	8⅞	—	5 12 2
Edison Swan, fully paid	—	—	2⅜	—	Nil
do. do. 4 per cent. Deb.	4	4	75½	—	5 6 0
Electric Construction	7½	7½	1¼	—	6 0 0
Gen. Elec. Pref.	6	6	10⅜	—	5 15 8
do. Ord.	10	10	19½	—	5 2 7
Henley	25	25	19½	— ½	6 8 2
do. 4½ Pref.	4½	4½	8⅞	—	5 12 2
India-Rubber	10	12	15½	+ ¾	*6 8 0
Telegraph Con.	20	20	43	—	*6 11 9

* Dividend paid free of income-tax.

MARKET QUOTATIONS.

It should be remembered, in making use of the figures appearing in the following list, that in some cases the prices are only general, and they may vary according to quantities and other circumstances.

Wednesday, March 13th.

CHEMICALS, &c.	Latest Price.	Fortnight's Inc. or Dec.
c Acid, Oxalic .. .. per lb.	1/6	..
a Ammoniac Sal .. .. .. per ton	£75	..
a Ammonia, Muriate (large crystal) ..	£72	..
a Bisulphide of Carbon	£33	..
a Borax	£38	..
a Copper Sulphate	£67 10/-	..
a Potash, Chlorate .. .. .. per lb.	2/6	..
a ,, Perchlorate	2/-	..
a Shellac .. .. per cwt.	£23 10/-	..
a Sulphate of Magnesia .. .. per ton	£16	..
a Sulphur, Sublimed Flowers	£35	..
a ,, Lump	£25	..
a Soda, Chlorate .. .. .. per lb.	1/-	..
a ,, Crystals .. .. .. per ton	170/-	..
a Sodium Bichromate, casks .. per lb.	..	..
METALS, &c.		
c Brass (rolled metal 2" to 12" basis) per lb.	..	..
c ,, Tubes (solid drawn)	..	..
c ,, Wire, basis	..	..
c Copper Tubes (solid drawn)	1/7 to 1/7½	..
g ,, Bars (best selected) .. per ton	£147	..
g ,, Sheet	£147	..
g ,, Rod	£147	..
d ,, (Electrolytic) Bars	£135	..
d ,, ,, Sheets	£152	..
d ,, ,, Wire Rods ..	£138	..
d ,, ,, H.C. Wire per lb.	1/3½	..
f Ebonite Rod	3/-	..
f ,, Sheet	2/6	..
n German Silver Wire	2/3	..
h Gutta-percha, fine	6/10	..
h India-rubber, Para fine	2/7½	½d. dec.
i Iron Pig (Cleveland warrants) .. per ton	Nom.	..
l ,, Wire, galv. No. 8, P.O. qual. ..	£43	..
g Lead, English Pig	..	..
g Mercury .. .. per bot.	Nom.	..
e Mica (in original cases) small .. per lb.	6d. to 2/-	..
e ,, ,, ,, medium ..	2/6 to 6/-	..
e ,, ,, ,, large	7/6 to 14/- & up.	..
d Silicium Bronze Wire .. .. per lb.	1/8½	..
r Steel, Magnet, in bars .. .. per ton	..	..
g Tin, Block (English)	..	..
n ,, Wire, Nos. 1 to 16 .. .. per lb.	4/2	1d. inc.

Quotations supplied by—

a G. Boor & Co.
c Thos. Bolton & Sons, Ltd.
d Frederick Smith & Co.
e F. Wiggins & Sons.
f India-Rubber, Gutta-Percha and Telegraph Works Co., Ltd.
g James & Shakespeare.
h Edward Till & Co.
i Bolling & Lowe.
l Richard Johnson & Nephew, Ltd.
n P. Ormiston & Sons.
r W. F. Dennis & Co.

The Value of Electric Power in Relieving Coal Shortage.—Now that the question of coal shortage in the U.S.A. has been brought so prominently to the attention of the public by the recent closing order of the Fuel Administrator, it is interesting to note the splendid work that is being done and the savings effected by the railroads that have adopted electricity as a motive power on a part of their lines.

On the Elkhorn grade electrification of the Norfolk and Western Railway, which is one of the biggest coal-carrying roads in the country, the 270-ton Baldwin-Westinghouse electric locomotives haul a 3,250-ton train of steel cars loaded with coal, en route for eastern points. Previously to the electrification it required three of the biggest modern type of Mallet locomotives equipped with mechanical stokers to haul a train of this tonnage up the Elkhorn grade at a speed of 7 miles an hour. Two electric locomotives haul it up the same grade at 14 miles per hour, double the speed formerly obtained by the steam locomotives.

With electric propulsion the same coal traffic can, therefore, be hauled with about one-third the former number of locomotives and half the number of engine and train crews. Of equal interest is the statement recently made by the Commission of Agriculture of the State of Montana in regard to the use of electric power by the Chicago, Milwaukee, and St. Paul Railway, now obtaining 160,000 KW. of electric power from the hydraulic plant of the Montana Power Co., and the saving in fuel effected by this use of water power instead of coal has been very gratifying to the State officials.

The Commissioner states :—"To give an idea of the value of the power which is being generated by these plants, it may be stated that to produce 160,000 KW. from coal would require the yearly consumption of 2,500,000 tons, which, at the average price of $4 which would apply at the points where the power is used, would amount to $10,000,000. When it is considered that the value of this coal is, by means of water power, being saved each year, and that during the next ten years this saving will, in all probability, be increased seven or eight times, it is not difficult to understand that true conservation consists in encouraging the rapid development of water power."

It has been estimated that the shortage of coal last year amounted to 50,000,000 tons; the saving therefore by this one company alone of 2,500,000 tons of Montana coal amounts to 5 per cent. of the total shortage in the country last year.—*Railway Review.*

LEAVES FROM AN ENGINEER'S LOG.

II.—The Trials of Sandy McNab.

By "WHISTLEFIELD."

Running the munition shop with boys was only a qualified success—they needed far too much supervision; and as the generation of electricity was our main business, and the making of shell a mere side line, the boys were a bit of a nuisance. There were too many hiding places about the station also to which they could retire for a smoke or a sleep, and it was no good threatening to sack them, for boys with any lathe experience at all were in great demand, and commanded good wages all over the town.

The Chief was rather keen to try women on the lathes, but Sandy had all the old-time practical engineer's contempt for innovations of any kind, and especially women among his machine tools; but in the end it was Sandy who asked for the girls. The boys nearly drove him to distraction, they were careless and lazy, and he could do nothing with them. When he cursed them, they cursed him back, and told him if he wasn't satisfied he knew what to do. Sandy did it, but got tired of continually teaching new boys; besides, the number of his scrap shell mounted up, so he began to listen less sceptically to the Second's reports of how well the women were doing in the various factories in the town, and when a quiet little lad to whom he had refused either an increase or a discharge note scrapped five shells in succession, Sandy capitulated, and told the Chief he could take on the women as soon as he liked, and that he would teach them.

The Chief and the Second talked the matter over, and decided that they must get a superior type of girl, so that there would be no larking between them and the lads. The first two candidates were daughters of one of the councillors. They were got up in great style, and didn't look as if they had ever done a day's work in their lives. The Chief tried hard to discourage them from doing munition work, at any rate under his roof, but they were very keen to try, and I was detailed off to show them the shop. We arrived just as Sandy, standing in the middle of the shop with his back to the door, was giving vent to his feelings on the subject of a boy who had broken some teeth on one of the lathes. I hadn't realised before how lurid Sandy really could be when he was roused. The two fair candidates wanted to know who that "horrid man" was, and when they found out that he was in charge of the munition makers, they did not wait to see any more.

Four girls were finally taken on for a first trial; three of them were selected as likely to shape well, but the fourth was the chairman's niece, and she selected us as the ones she would honour with her presence. She was extremely pretty, and knew it, and expected to be waited on hand and foot.

When she dropped a spanner or a tool, or got stuck with her work, which was pretty frequent, she would look round so appealingly that at least three lads would leave their lathes, and make a dive to help her; and she was so touchingly grateful, that they would watch her more closely than their own jobs, so as to be first to the rescue when she got into difficulties again.

Sandy raved inwardly, it was the only way in which he could express himself during the day shift. It was ludicrous to hear him burst out with "What the——" and then suddenly switch off into a very polite inquiry as to how the culprit could possibly have done such a thing. If the culprit was at the other end of the shop from the girls, he got the full benefit of Sandy's thoughts, but in a hoarse whisper. On one occasion when the provocation was unbearable, Sandy is said to have used Gaelic. Rodgers, who was working at the next lathe, and who had been invalided home from Mesopotamia, said, after hearing Sandy on that occasion, that he could quite believe his contention that Gaelic was the language of Eden, it sounded so satisfyingly expressive.

Day after day Sandy petitioned the Second to get rid of "Venus," and finally carried his request direct to the Chief. It took Sandy nearly half an hour to unburden his soul on the subject. The Chief had already heard all about it from the Second, and told him to get rid of her at once. When the Second asked him if there was any special reason he would like him to give the girl for her dismissal, the Chief answered irritably: "Tell her she is no damn good, and I'll explain to my Chairman to-morrow."

What the Second told her I don't know; they were talking together for a long time, then he sent me to tell the Chief that Venus had decided to leave of her own accord, and was coming up to thank him for all he had done for her.

I gathered afterwards from Venus herself, that the Second had expressed great concern at her working for so long with such heavy shell, in fact, he had made her quite sorry for herself, and finally persuaded her to stop that work at once, take a good holiday, and he would give her an introduction to the managers of two factories where the machines and work were much lighter and safer. I wonder what she would have thought if she had known that he had gone down to dismiss her, if more diplomatic methods had failed.

Venus was quite enthusiastically grateful to the Chief for giving her a chance to do her bit in the War, and the Chief was just going to expand on how pleased he had been to have her on the work when he saw the smile on the Second's face and cut it short.

When he asked the Second afterwards what he had said to her, he replied: "Exactly what you told me to say, but I did it in other words, so there will be no need for you to explain anything to your Chairman to-morrow."

The Electrical Industry in the U.S.A.—In the *Electrical World* of January 5th, a *résumé* is given of electrical progress in 1917, from which we learn that little technical advance has been made, under war-time conditions, but large outputs have been recorded. The total output of energy was about 27,000,000,000 KW.-hours, of which more than half was generated by water power; the remainder consumed only 4 per cent. of the total coal consumption of the country. In most cases the price of energy remains at peace-time rates. Manufacturers have been working at great pressure, largely on Government orders. The year has been the most prosperous in the history of the electrical supplies business, and profits have been good. Excellent progress has been made in research in connection with war problems. The drift in steam turbine practice has been towards large units, high steam pressure, and high temperature. An efficiency of 92·3 per cent. has been attained by a 5,250-H.P. horizontal water turbine installed at a paper mill, which is claimed as the highest recorded for the horizontal type; a vertical turbine some years ago reached 93·7 per cent., which is also regarded as the record for the type.

Continued attention is being given to the temperature rise in electrical generators. An 8,000-K.V.A., 44,000/6,600-volt, 60-cycle, self-cooled transformer has been set to work, and is believed to be the largest self-cooled unit in existence. An auto-transformer of 25,000 K.V.A., transforming 12,000 to 24,000 volts, and therefore controlling an output of 50,000 K.V.A., is being built.

Great progress has been made in the manufacture of high-pressure insulators. A new type of lightning arrester, with the characteristics of the aluminium arrester but entirely dry and requiring no charging, has been developed.

The demand for electric motors and controllers has been urgent. Important developments have taken place in storage battery practice, especially for Government use, but cannot be disclosed at present.

Mr. T. C. Martin, secretary of the National Electric Light Association, in the same issue deals with statistics. He estimates the revenue of central stations in 1917 at £110,000,000, an increase of 10 per cent. over 1916. The traction revenue is put at £160,000,000, an advance of one million. The total operating revenues of the Bell telephone system are estimated at over £58,000,000, and of the whole of the telephone systems at £85,000,000. Telegraph companies' earnings are expected to aggregate £35,000,000. Manufacturing revenue is uncertain, but Mr. Martin estimates it at £120,000,000; the General Electric Co. has stated that its orders for 1917 amounted to £48,000,000. Miscellaneous electrical industries are figured at £25,000,000. The grand total is £565,000,000, or an increase of about 10 per cent.

Molybdenite in Ontario.—An Eastern molybdenite company (says the Agent-General for Ontario) has secured an option on 200 acres near Kakabeka Falls. The vein has been proved to a depth of 50 ft., and a cross-cut shows it to be at least 16 ft. wide. The ore will grade over 1 per cent., or about 20 lb. to the ton.—*Financier.*

INSULATION UNDER DIRECT AND ALTERNATING CURRENT, PARTICULARLY AS REGARDS MOISTURE.*

By PROF. THORNTON.

(*Address delivered before the North of England Branch of the* Association of Mining Electrical Engineers.)

1. *The Electrical Structure of Matter.*—Matter is made up of minute electrical charges called electrons; the negative electrons are light, the positive electrons relatively heavy. Atoms are probably groups of negative electrons in motion, or grouped around a positive nucleus, or some aggregate of such systems. The difference between conductors and insulators is that in the former a stream of negative electrons can take place from atom to atom, forming an electric current in the conductor, while in dielectrics or insulators electrons cannot be separated from the atomic structure except under great electrical forces. What happens in the insulation of a cable is that the insulating material becomes polarised; that is, there is a separation or displacement of charge in the atoms of the material, so that if the wire is positive, the side next to it acquires a negative charge, the side next to the sheath an equal positive charge.

2. *Residual Charge.*—This separation of charge is aided by the mutual attraction between neighbouring charges (fig. 1), which causes a slow polarisation added to that first started by the applied voltage, which may grow for 48 hours. It is this that gives rise to residual charge in condensers. The voltage on the conductor of a cable left insulated after being charged for a long time by unidirectional voltage may be much greater than the original charging voltage. For $v = Q/K$, and a small quantity Q soaking out of the standing insulation after the voltage has been cut off can, if the capacity K of the cable is small, cause the voltage v to reach very high values.

There is no residual charge with alternating current, for there is little time to establish the mutual attraction between molecules before the field is reversed. This is the first significant difference between continuous and alternating-current distribution, though it plays no very important part in practice, except, perhaps, in breakdown voltage.

3. *Breakdown Voltage and Frequency.*—The voltage per unit thickness at which an insulating material can be broken down depends greatly on the time of application of the voltage, or on its frequency in the case of alternating voltages. The relation has the shape shown in fig. 2, the formula for which is :—

$$v = v_\infty \left(1 - \epsilon^{-an}\right) + v_0 \epsilon^{-an}.$$

So that when n is large, ϵ^{-an} is small, and v approaches the value v_∞. When n is zero, that is for steady voltage, v is large. This is due to viscosity preventing charge taking up the proper electric stretch.

4. *Nature of Breakdown.*—The nature of the process by which a dielectric, such as india-rubber or glass, breaks down, is still obscure. When the voltage is applied, the charges, which are always in the molecules, are separated; that is, the negative charge in one molecule approaches the positive charge in the next in line. When the force due to their own attraction, aided by the external field, bringing these together, exceeds that which the mechanical structure of the atom can support, the negative charge at some one point rushes across to the next atom, and there is a slip of negative charge along a line of molecules; that is, along the path of breakdown. The molecules exchange negative electron partners all along the line. This produces a kind of internal explosion. It is not a spark driven from outside through the insulation, but a slip of charge within it. If the damage to the molecular structure by this slip is sufficiently great, the original "puncture" may be followed by a rush of current from the circuit much greater than that at breakdown, but it is possible for the insulation resistance of a system to be better after a spark through it than before. This has been known to happen.

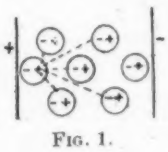

Fig. 1.

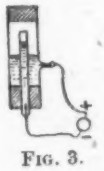

Fig. 3.

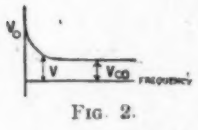

Fig. 2.

Fig. 4.

5. *The Breakdown of a Cable* is, under certain circumstances, facilitated by porosity giving rise to osmosis. Evershed has pointed out the enormous importance of osmosis, especially of what is called electrical endosmose, in the phenomena of insulation. There may be a surface creep of water by a process which is extremely interesting to watch under the microscope. Small drops of moisture form on any surface below the dew-point, and when these are electrified they run together by a kind of spray effect from the side next to the live conductor, so that a film eventually forms. Wax on the surface stops this. A good illustration of how it occurs is given by the following simple apparatus:—A glass tube with rubber stoppers (fig. 3), partly filled with water, contains an inner tube having at the bottom a platinum wire fused in. A wire through the side is connected to a Wimshurst machine, and it is found that water collects in the negative part of the tube. That is, it is carried over from positive to negative. Reversing the polarity, the water returns and piles up in the opposite direction. Water always goes in the same direction as a current would flow. The reason for this is not very clear, but it would appear to be that the edges of the water film form, as it were, a fine point or wedge, and the electrical forces at a point, such as a lightning rod or a needle, are, as is well known, much larger than those at a rounded surface. The film is, therefore, torn up and sprayed onward, so that the water advances along the surface like a molecular watering cart, with the spray in front.

This effect is even more marked in fine capillary tubes or thin layers than on a free surface, and plays an important part in vegetable growth.

6. *Under Direct Current*, moisture between cables is urged along the lines of force from the positive to the negative conductor (fig. 4), and if there is a fault—or two faults, or a generally faulty cable—moisture penetrates the negative insulation and gathers next to the conductor, forming sometimes a kind of sac full of liquid. In one case it was found necessary to cut the cable and put in a drainage tank holding a gallon or two, which filled in a few weeks by moisture driven through the insulation in this manner.

Experiments were conducted by Mr. Vernier, of the Newcastle Supply Co., which illustrated this clearly. Cables were buried in damp ground and connected to the supply network at 240 volts. When the voltage was direct, the leakage of current rose slowly in 45 hours to one ampere; moisture collected at the negative cable in large quantities with evolution of steam. When the voltage was alternating, the current at switching on was 1·5 amperes, but fell in a few hours to zero. That is, an alternating-current fault dries itself out completely under the most unfavourable conditions, while a direct-current fault gradually but surely gets worse until the insulation in its neighbourhood is completely destroyed by the passage of the moisture and the heat of the leakage current.

Prof. Thornton gave the appended figures, which showed that a very faulty direct-current system, on being converted to alternating current, cured itself automatically, and last year had only one fault. Facts like these, he said, were conclusive that A.C. supply in moist ground, or wherever moisture had access to the insulation, was very much safer than direct current. The figures were :—

	Year.	No. of faults.
Direct current	1909	210
	1910	162
	1911	171
Transition	1912	114
	1913	59
Alternating current ...	1914	15
	1915	14
	1916	1

* From the *Iron and Coal Trades Review.*

The "Safety First" Movement.—A record of the activities of the London "Safety First" Council—a body formed in December, 1916, to promote increased safety in the use of the streets and railways within Greater London—was submitted at the first annual meeting of the organisation. Among the members of the Council are representatives of 45 local authorities (six of whom control tramway undertakings), several railway, tramway, and omnibus companies, vehicle workers' associations, technical societies, professional organisations, and commercial firms. During the nine months ended September, 1917, the number of street accidents within the Metropolitan Police District showed a reduction of 10 per cent. on the total for the corresponding portion of the preceding year, and the number of persons killed in the streets fell from 577 to 489. An attempt has been made to systematise the methods of street illumination and the lighting of vehicles, with a view to the convenience of traffic in the darkened streets. Competitions and awards have aided in arousing interest in the Council's objects. —*The Times.*

Battery v. Magneto Ignition in America.—A census was taken at the recent motor-car exhibitions in New York and Chicago, which revealed the fact that, taking the different makes of cars displayed, the number fitted with battery ignition had increased from 56·4 per cent. in 1916, and 72·2 per cent. in 1917, to 77·5 per cent. for the current year, there being a corresponding decline in cars fitted with magneto ignition from 43·6 per cent. and 27·8 per cent. to 22·5 per cent. The tendency is, of course, mainly due to the fact that practically all American cars are now fitted with dynamos and batteries for lighting purposes, the batteries being also used to furnish current for ignition.

PROCESSES FOR THE MANUFACTURE OF ALUMINIUM.

(*Concluded from page 222.*)

Operation.—In order to start the furnace, the upper electrodes are brought down on to the lower electrodes with the intervention of a small resistance, generally provided by small pieces of carbon. Cryolite alone, or mixed with fluxes, is added gradually to the furnace, and when these materials are molten the current is increased to its normal value, more material being added meanwhile. The anodes are raised slowly, and when the volume of the bath is sufficient, alumina is added and stirred frequently to favour its solution. In order to protect the bath continuously against the cooling and oxidising influence of air, it is covered with a layer of powdered alumina. As the deposition of aluminium proceeds, more oxide must be added from time to time, and an ingenious means of indicating when more oxide should be added consists of an incandescent lamp (or several in series) shunted across the terminals of the furnace, the resistance of the filaments being chosen so that the lamps light up when the percentage of alumina in the bath is insufficient. Cryolite and fluxes have generally to be added at intervals of several days.

It is essential that the density of the bath be lower than that of molten aluminium, in order that the latter may sink to the bottom, where it must be protected continuously against oxidation by a sufficient depth of molten salts. Solid cryolite has a density of 2.92, but this falls to 2.08, giving a margin of 0.46 compared with the density of molten aluminium, which is 2.54. The addition of alumina and fluxes does not increase the density of the bath, and inversion of densities due to incorrect composition of the bath occurs very rarely.

If an aluminium furnace becomes too hot, the flame round the anodes extends and becomes yellow. The remedy is to lower the anodes. Metal collects continuously at the bottom of the furnace, and is tapped at intervals of two or three days, according to the dimensions of the furnace. Tapping is effected not directly, but into a ladle which retains fluorides in the solid state.

Furnaces are best installed in a single line or in parallel rows in a large building. There are other arrangements less expensive in first cost, but also less convenient in working, and favouring the accumulation of heat.

Efficiency, &c.—The efficiency of an individual furnace during normal operation varies from 90 to 95 per cent. of the theoretical value, but the overall annual efficiency varies with the number of furnaces used simultaneously, with the power of each furnace, and with operating mishaps. According to M. Flusin, the average production ranges from 460 to 605 lb. of aluminium per KW.-year, corresponding to an energy expenditure of 1.86 to 1.41 KW.-hour per lb. of metal, and an industrial efficiency of from 58 to 76 per cent.

As regards consumption of materials, this amounts to 2 lb. of alumina, and from 0.7 to 1 lb. of anodes (including stumps) per lb. of aluminium produced. The consumption of cryolite and fluxes is very small (say 0.12 to 0.2 lb. of cryolite and 0.2 lb. of calcium and aluminium fluorides); the wastage of these materials is due to secondary electrolysis volatilisation and loss in crushing, and may be reduced by skilful manipulation.

Alternative Processes.—If one attempts the electrothermic reduction of alumina alone, there is the risk that part of the aluminium may be volatilised and reconverted to alumina, whilst the remainder may be converted to carbide. The Cowles process is based on the reduction of alumina by carbon in the presence of iron and copper, at the temperature of the electric furnace. The products obtained are pure aluminium, and an alloy, viz., ferro- or cupro-aluminium.

The Tucker and Moody process uses a mixture of alumina, 150 parts; calcium carbide, 200 parts; and coke, 60 parts. Calcium carbide is first formed by reaction between lime and carbon at the temperature of the electric arc. The exothermic nature of this action develops enough heat to facilitate the reduction of alumina, but unless the process is completed quickly there is considerable risk of forming aluminium carbide.

The preparation of aluminium from its silicates, *i.e.*, clays, offers great possibilities of cheapening the metal. In the Cowles-Kayser process, ordinary clay is mixed with carbon and sea-salt; the mixture is heated to 1,000 deg. C. and yields, besides valuable by-products, a complex silicate of aluminium from which alumina is prepared by the action of quicklime.

It is claimed that by the Moldentrauer process the price of aluminium is reduced to 2.15d. per lb. A mixture of crushed clay, hematite and coke is subjected to the action of a heavy current. By using a suitable proportion of iron oxide, and adding part of the iron in the form of ferro-silicon, the furnace may be made to yield a mixture consisting almost exclusively of ferro-silicon and alumina. The latter is crushed and passed through a magnetic separator to remove globules of ferro-silicon. The yield of aluminium is about 70 per cent. of the theoretical value. Ferro-silicon with high silicon content is obtained from the first electric furnace, together with impure alumina which is melted and electrolysed in a second furnace.

Production and Consumption of Aluminium.—Until 1896 Switzerland produced more aluminium than any other country. Now, however, the annual production is, roughly, as follows:—

United States and Canada	18,000 tons.
France	15,000 tons.
Germany and Austria-Hungary ...	10,000 tons.
Switzerland	6,000 tons.
United Kingdom	3,000 tons.
Norway	1,500 tons.
Italy	1,000 tons.

France exports the most aluminium, and is at the head of the European market. French deposits of bauxite yield 130,000 tons per annum (out of a world's total of 170,000 tons), and since the expiration of the Heroult patents in 1907, the number of aluminium works in France has increased rapidly. The Soc. Electrometallurgique Francaise produces 9,000 tons of aluminium per annum from its works at Largentiere, La Praz, and La Saussaz; the Cie. des Produits Chimiques d'Alais, &c., produces 7,000 tons from works at Calipso, St. Jean, and St. Felix de Maurienne, and Pontamafrey; the Soc. d'Electrochimie produces 1,000 tons at Premont; and the Soc. des Produits Electrochimiques des Pyrenees produces 3,000 tons at Auzat. The principal works are thus in Savoy, in the valley of the Maurienne; between Modane and St. Jean there are six works representing 80,000 H.P.

The principal aluminium companies outside France and their annual outputs are:—Aluminium Industrie Gesell.: Neuhausen 1,000 tons, Chippis 4,000 tons, Rheinfelden 600 tons, Lend-Gastein 1,200 tons. British Aluminium Co.: Foyers 800 tons, Stangfjord 1,000 tons. Aluminium Corporation: Dolgarrog 1,800 tons. Anglo-Norwegian Aluminium Co.: Vigeland 500 tons. Soc. Italiana dell'Alluminio: Bussi Pescara 1,200 tons. Soc. Italienne d'Aluminium: Popoli 1,000 tons. Aluminium Co. of America: (Niagara, Massena, Quebec, and Shawinigan) 18,000 tons.

In the whole world there is about 350,000 H.P. devoted to the production of 60,000 tons of aluminium. For a year or two after the expiration of the Heroult patents (1907) there was over-production, but the demand then overtook the supply, and since 1910 there has been a fair state of equilibrium between production and demand. Since the beginning of the war the use of aluminium and its alloys for munitions purposes has extended enormously, and there can be no doubt that aluminium (and its alloys), which is already in the sixth place in the scale of metals commonly employed, will rise much higher still. In the form of clay, aluminium is the commonest of all metals, and in view of the great extent to which it is now employed for all manner of purposes it is interesting to recall that it was almost a precious metal in 1855, when it cost £23 per lb. In 1866 the price fell from £2 5s. to 28s. a lb.; by 1890 it had reached 7s. per lb.; and for 10 years past the price has been about 8d. a lb.

Electric Truck Service in Chicago.—The Commonwealth Edison Co., of Chicago, has recently brought into service an electric garage, in connection with which a complete garage and maintenance scheme for commercial electric vehicles has been introduced. The primary idea is to offer a service in which all transportation costs are guaranteed. Only new electric trucks of standard type and equipment are to be given the benefit of the new service, which covers storage and cleaning, battery charging, maintenance and upkeep of gearing parts, including batteries, tires, &c. This maintenance covers ordinary upkeep of minor repairs as well as renewal of tires and batteries, when necessary; it also includes painting the body, it being intended to leave the vehicle practically like new, ordinary wear and tear excepted, at the end of the four years' contract period. The cost of rendering the service has been based on the company's own experiences, extending over 15 years, with a fleet that has grown to 182 cars.

The service is charged for on a monthly flat rate, depending, of course, on the type of vehicle and its equipment, and including a normal battery charge each day; additional charging, boosting, or the use of an extra battery would necessitate an increased rate. The rate depends on the average service rendered, and, being a fixed flat rate, enables the owner to know what his transportation will cost each year, when taken in conjunction with drivers' wages, interest, insurance and taxes.

The garage, known as Service Station No. 1, holds about 100 vehicles; other stations are to be built as occasion may demand. Direct current energy at 115-230 volts is led in from two sources, the cables terminating in 1,500-ampere triple-pole switches on the control board; 58 charging circuits are provided, these running overhead to points on the ceiling directly over each charging outlet.

A special junction or terminal-box is provided over each outlet; in this connection is made to a flexible cable hanging loosely from the box, the cable being securely anchored in the box; at 5 ft. above floor level, a double-pole connecting receptacle is fitted from which a short flexible jumper is connected to the vehicle under charge. With this arrangement careless starting of the vehicle only results in opening the lower connecting receptacle. A special washing rig is provided, in which the action of pulling down the hose starts the flow of water, while the next pull stops it; this saves wear and tear of hose on the floor, and saves water, which is an important matter in winter, when warm water is supplied.—*Electrical Review* (U.S.A.), Vol. 71, No. 26.

THE RÖNTGEN SOCIETY.

At the meeting of the Röntgen Society on March 5th, Mr. Howard C. Head gave a demonstration, accompanied by kinematograph views, of a mobile X-ray wagon unit which has been constructed by Messrs. Siemens Bros., Ltd., for service on the Mesopotamia front (a similar equipment has been in use for some time in France). He said that the designing of a travelling X-ray ambulance opened up great possibilities alike for the automobile and the electrical engineer, and the value of such an equipment was obvious, for by this means it became possible to have the X-ray apparatus and its power unit taken to its work, instead of the work having to be brought to some centre where current was available. A particular form of chassis was chosen for its low loading line, which made it practically equal to the underslung type of car; the panel teak body mounted on the chassis was about 13 ft. long by 7 ft. wide, and was divided into two compartments, one of them a photographic dark-room, and the other the room containing the X-ray apparatus. In addition, the caravan carried a portable X-ray theatre, formed by means of a framework of poles and tie-rods erected at the side of the car, over which a tent canvas roof and sides could be adjusted. Turning to the electrical equipment of the vehicle, Mr. Head said that the generator was situated on the exhaust side of the engine, and was driven by means of a Westinghouse-Morse rocker chain from the main shaft of the engine. It was designed to give an output of 3 kw., or 20 amperes at 150 volts when the engine was running at 1,700 r.p.m. The rocker chain was disconnected when the car was running on the road, and was only connected when the generator was to be used either for running the X-ray plant direct or for charging the battery of accumulators. This battery was fitted in two special cupboards at the back of the driver's cab, and the doors of these cupboards were fitted with louvres to ensure perfect ventilation; by this arrangement no acid fumes could enter the car. The battery was built up in special ebonite composition boxes, which were superior to celluloid, because the latter material decomposed under the influence of heat. The battery consisted of 38 2-compartment, 4-volt units, making 76 cells in all of the sealed-in type, and the capacity of each cell was 80 ampere hours (intermittent), or 10 amperes for 2½ hours, or 30 amperes for 5 minutes. Therefore the X-ray operator was provided with a supply of energy capable of undertaking the quickest work and the most difficult cases, for he could run the generator and accumulators in parallel. The X-ray equipment provided was the standard War Office equipment for field service, together with various additions, including a Coolidge control outfit, a number of tungsten target tubes, an intense discharge induction coil, and three interruptors of different types. The connections were so arranged that X-ray work could be done either in the car itself or in the canvas annexe, or, by means of cables from the power apparatus, in the room of a hospital or house. Mr. Head said that the unit would have a utility even after the war was over, as, for instance, in mining districts and in scattered areas where no established X-ray plant was available within a convenient distance.

At the same meeting Dr. C. R. C. Lyster and Dr. Sidney Russ read a paper on "A Biological Basis for Protection against X-rays," in which they described a photographic method (in preference to an electroscopic one) of discovering the amount of X-rays to which the operator was subjected in the course of his daily duty. In the subsequent discussion the opinion was expressed by more than one medical man that susceptibility to X-ray dermatitis differed greatly according to the individual, and that in view of this element of personal idiosyncrasy it was almost impossible to lay down hard and fast rules as to the damaging dose.

NEW PATENTS APPLIED FOR, 1918.

(NOT YET PUBLISHED.)

Compiled expressly for this journal by Messrs. W. P. Thompson & Co., Electrical Patent Agents, 285, High Holborn, London, W.C., and at Liverpool and Bradford.

3,268. "Electric starters and controllers." E. Schattner & J. R. Walton. February 25th.

3,272. "Magneto drives of motor cycles, &c." James Cycle Co. & W. F. Lechmere. February 25th.

3,277. "Electric cables." W. J. Howard. February 25th.

3,283. "Electric controllers of the barrel type." W. G. Pipkin and Veritys, Ltd. February 25th.

3,303. "Variable resistances of rheostats." Siemens & Halske Akt. Ges. February 25th. (Germany, February 15th, 1917.)

3,304. "Automatic telephone systems." Automatic Telephone Manufacturing Co. February 25th. (U.S.A., March 19th, 1917.)

3,305. "Automatic telephone systems." Automatic Telephone Manufacturing Co. February 25th. (U.S.A., May 23rd, 1917.)

3,308. "Cells or boxes for power and lighting electric accumulator for train lighting, central stations, and submarines." A. V. Downton. February 25th.

3,330. "Automatic snow-shaking apparatus for electric lines." V. Cisari. February 25th. (Italy, April 30th, 1917.)

3,333. "Machine switching telephone exchange systems." L. Polinkowsky & Western Electric Co. February 25th.

3,335. "Electric conductors." A. Brandes, Elektro-Elevator Brandes and Winkler & A. Winkler. February 25th.

3,351. "Electric signalling apparatus." H. E. Crammond & C. E. Falconbridge. February 26th.

3,379. "Alternating-current dynamo-electric machines adapted for synchronous working." L. J. Hunt & Sandycroft, Ltd. February 26th.

3,381. "Means for preventing electric conductors of traction systems being coated with ice." P. C. Edwards. February 26th.

3,396. "Insulated conductors." J. A. L. Dearlove. February 26th.

3,397/8/9. "Generating power." Westinghouse Machine Co. February 26th. (U.S.A., August 11th, 1916.)

3,408. "Electric light fittings and brackets." L. Harrison & E. R. Hough. February 26th.

3,414. "Electric accumulators." Chloride Electrical Storage Co. & H. Dean. February 26th.

3,418. "High-voltage distributors for electric ignition apparatus." Akt. Ges. Brown, Boveri et Cie. February 26th. (Germany, March 14th, 1917.)

3,430. "Process for making metals in electric furnaces." E. Humbert. February 26th.

3,430. "Accumulators, &c." V. G. Youriett. February 26th.

3,431. "Manufacture of iron by electrolyses." C. Ageano. February 26th. (Italy, March 19th, 1917.)

3,436. "Electric oil heater." R. B. H. Gossage. February 27th.

3,440. "Electromedical apparatus." E. E. Greville. February 27th.

3,446. "Electric height-indicator." R. B. T. Pinkney. February 27th.

3,452. "Manufacture of electric cells." O. Silberrad. February 27th.

3,457. "Electric reversing switch mechanism." R. K. Wallace. February 27th.

3,460. "Supply of electrical energy to furnaces, &c." W. Travis and T. H. Watson & Co. February 27th.

3,478. "Attachment of telegraph wires to insulators." W. A. Davis. February 27th.

3,480. "Combination of telegraph and telephone apparatus." L. E. Austing. February 27th.

3,496. "Dynamo-electric machines." G. Plaisant. February 27th.

3,497. "Dynamo-electric machines." G. Plaisant. February 27th.

3,505. "Production of spongy lead." V. G. Youriett. February 27th.

3,526. "Sparking plugs for explosion motors." Soc. Anon. Carburateur Aris. February 27th. (France, March 16th, 1917.)

3,530. "Machine switching telephone exchange systems." L. Polinkowsky and Western Electric Co. February 27th.

3,532. "Carbon conductors." G. N. Antonoff. February 27th.

3,541. "Method of electrification of the soil for farming." R. F. Hall. February 28th.

3,542. "Method of electrification of seed and grain." R. F. Hall. February 28th.

3,548. "Electric cables." W. J. Howard. February 28th.

3,575. "Dynamo-electric machines." J. W. Burleigh. February 28th.

3,577. "Method of generating pressure." Westinghouse Electric and Manufacturing Co. February 27th. (U.S.A., March 31st, 1917.)

3,584. "X-ray tube stands." C. E. S. Phillips. February 28th.

3,601. "Electric motors." E. S. Franklin and Stothert & Pitt. February 28th.

3,617. "Starting switches for electric motors." Officine Elettro-Meccaniche & W. P. Thompson. March 1st.

3,623. "Jointing electric cables." W. J. Howard. March 1st.

3,643. "Gas and electric fittings, candlesticks, &c." J. Harrington. March 1st.

3,650. "Sparking plugs." G. Parsons & T. C. E. Rowland. March 1st.

3,656. "Lamp mountings for electric light projectors." Stewart-Warner Speedometer Corporation. March 1st. (U.S.A., June 19th, 1917.)

3,660. "Electric batteries." G. N. Antonoff. March 1st.

3,670. "Electric switches and contacts." F. A. Ross. March 2nd.

3,676. "Transmission of electrical energy." P. W. Gray. March 2nd.

3,690. "Dynamo-electric machinery." J. W. Burleigh. March 2nd.

3,708. "Electromagnetic clutches." T. S. Duncan & Vickers, Ltd. March 2nd.

3,709. "Slip-ring short-circuiting and brush-contact releasing gear." A. H. Bennett & Phoenix Dynamo Manufacturing Co. March 2nd.

3,718. "Couplings or connecting devices for electric circuits." V. H. Broc. March 2nd. (France, March 14th, 1917.)

3,721. "Means for starting internal-combustion engines." J. Etchells, C. H. Stedman & Vickers, Ltd. March 2nd.

3,722. "Switches for controlling electric motors." J. Etchells, C. H. Stedman & Vickers, Ltd. March 2nd.

3,726. "Electric furnaces." J. Bibby. March 2nd.

PUBLISHED SPECIFICATIONS.

The numbers underlined are those under which the specifications will be printed and abridged, and all subsequent proceedings will be taken.

1916.

17,452. Variable-speed Generators and Storage Battery Systems. H. A. Gill (U.S. Light & Heat Corporation). December 5th, 1916. (113,108.)

18,389. Safety Apparatus for Preventing Increases of Potential in Electric Installations. E. C. R. Marks (E. Uytborck). December 26th, 1916. (113,110.)

1917.

362. Electric Heating Devices. British Thomson-Houston Co. (General Electric Co., U.S.A.) January 18th, 1917. (113,118.)

1,796. Electric Fuses. Simplex Conduits, Ltd., L. M. Waterhouse and J. F. Avila. February 5th, 1917. (113,130.)

1,867. Electromagnetic Switches. Igranic Electric Co. (Cutler-Hammer Manufacturing Co., U.S.A.) February 6th, 1917. (113,132.)

1,930. Art of Metering Electricity. E. O. Schweitzer. February 8th, 1917. (113,139.)

1,962. Electric Ovens. J. Bradley. February 8th, 1917. (113,142.)

1,985. Electric Lamp Locks. J. H. Collie. February 9th, 1917. (113,145.)

2,268. Electromagnetic Switches. British Thomson-Houston Co. (General Electric Co., U.S.A.) February 15th, 1917. (113,150.)

2,320. Electric Switch. H. G. Longford, W. W. Longford & W. A. Clark. February 16th, 1917. (113,152.)

3,615. Electric Couplings. H. de la Valette. March 31st, 1916. (105,227.)

4,147. Oil-insulated Electric Apparatus. A. Duckham & Co. and S. E. Bowrey. March 21st, 1917. (113,172.)

4,679. Electrical Switches. J. Roberts. March 31st, 1917. (113,176.)

5,067. Telegraphic Receiving and Tape-perforating Apparatus. A. L. Muirhead, A. C. Huskingson and Muirhead & Co. April 10th, 1917. (113,184.)

6,046. Composite Electric Insulating Substances. J. L. Major & P. J. Pybus. April 28th, 1917. (113,194.)